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Graphic Check on Glass Works Operation

By Walter J. Knothe*

The manufacture of glass today is very much different from what it was ten or fifteen years ago. There has been a wonderful development in this field during that time, principally in the manufacture of the ware after the glass batch has been melted. Machines have been developed for manufacturing practically every kind of glassware, eliminating to a very large extent the skilled glass blower and also cutting down very materially on the common labor required around the glass factory. The use of such machines has made it necessary to increase the capacity of glass furnaces in order to supply sufficient glass to keep the machines operating continuously. This increase in furnace size has been especially marked since the introduction of automatic feeders which have speeded up the output of the machines very materially.

The mixing of the glass batch, the melting of same and the manufacturing of the ware is now on a much more scientific basis than ever before. The management of the factory is also on a much more scientific basis. The output of ware per man is much greater. The cost per unit of ware is considerably less than ever before, therefore a loss at any point, from the melting of the glass to the packing of the ware, means a greater proportionate increase in cost of ware than under the old rule of thumb method of operation. This scientific management requires very careful supervision and a continuous check on the operation of the plant in all its details.

The glass works manager or superintendent, in order to handle his work to the best advantage, must plan and think along scientific lines. He must realize the importance of having every detail of the plant operation on the most efficient basis. In order to do this, it will be necessary to have some system of regular reports which will afford an opportunity for comparison of the works' operation from day to day or from week to week. These reports must be clear and concise. One of the principal values of such a report system is that it brings to the manager's attention at once any irregularities in the operation of the plant or of any single unit therein.

It is possible to compare figures on these reports from time to time, but they can be made of vastly more value if the facts given thereon are transferred to charts. A proper system of charts will show the operation of the factory in a clear and comprehensive manner. The manager will be able to visualize the operation of the factory at a glance and any irregularities will be so apparent as to eliminate any chance of their being overlooked.

The chart may be made to show the highest efficiency obtainable on any given piece of apparatus or on the plant as a whole and when the daily reports are charted against such a line, it will show how nearly the daily operation approaches such a maximum and whether it is coming nearer to this point from day to day or whether it is gradually dropping away. Such information cannot help being of real assistance.

The particular chart herewith presented is intended for use in checking the operation of a glass tank furnace and producers. When it becomes necessary to build a new factory or to plan extensions to an existing works, this chart will be of service in determining the size of tank to be installed for any given production. Its real value, however, to the operating man, is in that it affords an easy method of checking the daily operation of his existing tank furnace and producers.

From reports showing the tonnage of glass produced and the coal used, the chart will indicate the tons of coal used per ton of glass melted, thus giving a definite figure representing this relation. If this is done for daily or weekly reports, a definite comparison is available.

The chart may be made of still greater service if a line be drawn on it representing efficient operation of the particular furnace and producer installation on which it is to be used. This can readily be done by marking the points representing the tons of coal used per ton of glass melted covering a week's normal operation and drawing a line, as nearly as possible, through these points to the zero line on the chart. Such a line will then establish normal operation for the particular installation in question and the daily operation can then be compared to this line.

If the tons of coal per ton of glass melted as indicated by these reports falls appreciably below the line, the manager or

*Assistant Chief Engineer, Russell Engineering Co., St. Louis, Mo.

superintendent will know at once that the operation of the installation is not up to normal and that there is something wrong and will have an opportunity of correcting it at once, whereas without some check of this nature such a condition might easily exist for some time before being recognized.

As an example, the operation of the tank just after burning out the producer flues may bring the point to the normal line and as the flues gradually fill with soot, the point may drop below this line from day to day until the flues are again cleaned. Such a condition will very quickly show whether it is advisable to burn out the flues more frequently than present practice or whether it might be satisfactory to increase the time between burn-outs.

The chart will also show the loss in efficiency when the tank is being operated below or above its rated capacity.

Where a number of tanks are in operation in the same factory a comparison of charts worked up in this way will show the relative efficiency of the different units and of the operators in charge.

A little consideration will indicate a number of additional advantages to be derived by the use of this chart. It will have a tendency to cause the furnace operator to watch his furnace conditions more closely and the producer operator to watch his producer operation so as not to have the efficiency fall below the normal line as they will know that it is a simple matter to check up such operation and that the manager will know at once whether the operation of the installation is improving or gradually dropping off.

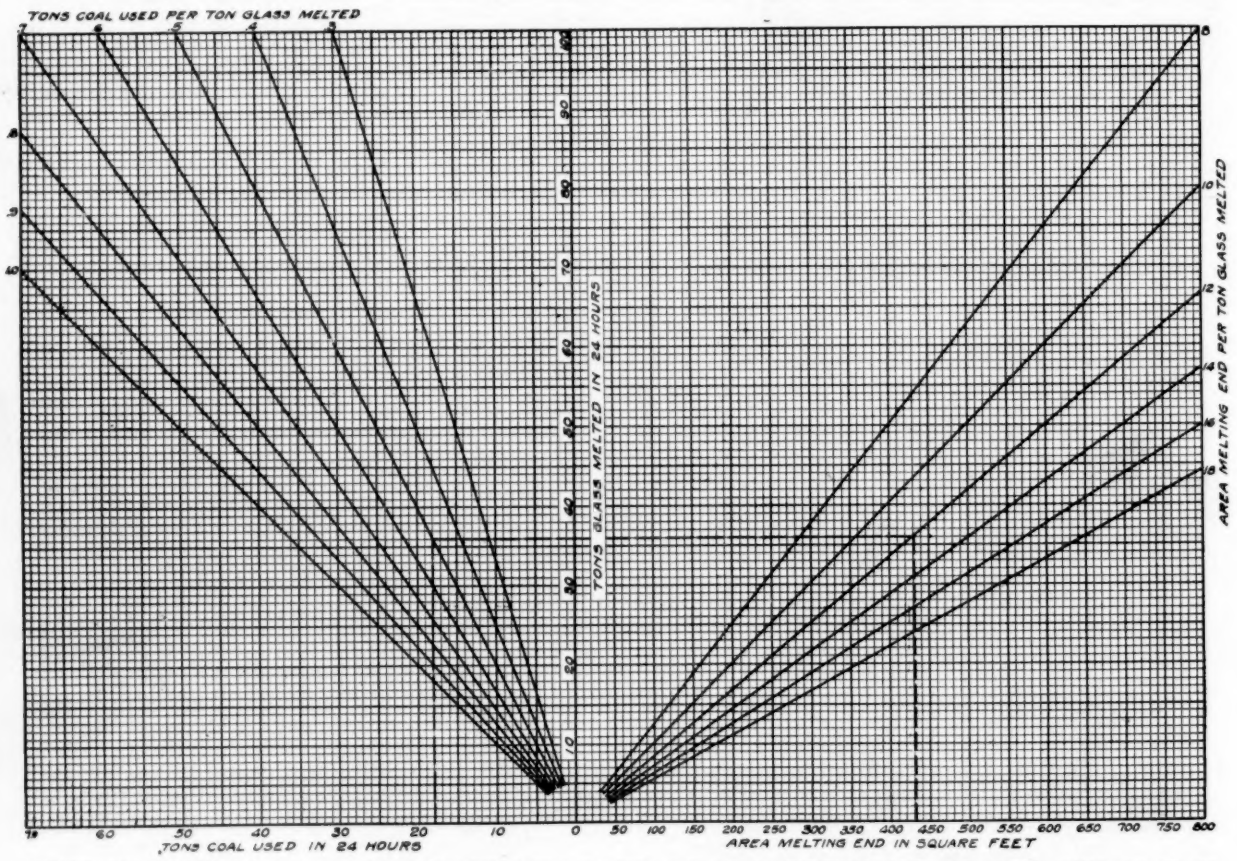
TONS COAL USED PER TON GLASS MELTED
TONS GLASS MELTED IN 24 HOURS
AREA MELTING END PER TON GLASS MELTED
TONS COAL USED IN 24 HOURS
AREA MELTING END IN SQUARE FEET

CHART FOR CONTINUOUS GLASS MELTING FURNACES SHOWING RELATION BETWEEN AREA OF TANK—TONS OF GLASS MELTED—TONS OF COAL USED

Method of Using Chart

Assume the probable weight of coal required to melt one ton of glass, also the area of the melting end of the furnace per ton of glass to be melted. These assumptions should be governed by the type of producers, the kind of coal and the kind of glass to be melted.

Starting at a point indicating the capacity of furnace in tons of glass to be melted in twenty-four hours on the vertical line at the center of the chart, follow the horizontal line to the diagonal line representing the area of the melting end of the furnace in square feet per ton of glass melted, then follow the vertical line to the bottom of chart where the required area of the melting end of the furnace for the assumed capacity will be indicated.

Similarly, to determine the tons of producer coal required, follow the horizontal line to the diagonal line representing the tons of coal required per ton of glass melted, then follow the vertical line to the bottom of chart where the tons of producer coal required in twenty-four hours for the assumed capacity will be indicated.

For existing installations this chart will be of service for determining the tons of coal used and the area of melting surface per ton of glass melted.

The point of intersection between the horizontal line indicating the tons of glass melted in twenty-four hours and the vertical line indicating the melting area of the furnace will show on the diagonal lines the melting area of the furnace per ton of glass melted per day. Should this point fall between the diagonal lines, its value can easily be determined by interpolation.

Similarly, for determining the tons of coal used per ton of glass melted, the left side of the chart may be used.

The heavy dash line indicates method of using chart.

[Copies of this chart can be obtained without charge by addressing the Russell Engineering Company, St Louis, Mo.]

If the chart is used for checking furnace operation there will be a very tangible advantage in the mere fact that it will cause the furnace and producer operator or superintendent to think of his operation in tons of coal used per ton of glass melted and in number of square feet of tank area per ton of glass melted. The first of these figures means efficiency in operation and the second capacity obtainable for a given unit.

The fact is also brought home to the operator of the very material saving effected by efficient operation as it presents in a very graphic way the actual loss in coal per ton of glass melted whenever the operation at any time falls below the normal line.

It also shows the advantage of having a well designed furnace and producer installation capable of being operated at a high efficiency and so arranged that this efficiency can be maintained in daily operation. In order to obtain such a furnace it must be designed according to well established scientific formulæ and built by experienced furnace builders.

It will be of advantage to draw a vertical line on the right-hand side of the chart indicating the melting area of the tank in square feet. By projecting the tons of glass melted as indicated on the reports to this line the number of square feet of tank area used per ton of glass melted will be shown.

If daily records are not available the chart can readily be used on weekly reports by changing the scale of the chart. The easiest way to do this is to multiply all figures shown on the chart for glass and coal by ten.

The Manufacture of Thermos Bottles in Germany*

By Carl Loechner†

The following is a description of the manufacture and composition of thermos bottles, which has expanded very considerably since 1919. Important in the first place is the composition of the batch. When bottles crack at the juncture of the outer and inner flasks it is clear proof of faulty chemical composition of the glass. Another evidence of poor composition is when the finished bottle cracks the first time it is filled with hot liquid. It is advisable to use for thermos bottles only those grades of sand which contain from 3 to 4 per cent alumina, which, up to a certain limit, renders the glass easier to melt and also increases its resistance against heat and chemicals. Besides alumina the sand also contains iron oxide, which, however, is of no importance in the case of thermos bottles. On the contrary, many thermos bottle makers claim that glass melted with Martinroda sand, and having a green color, due to the iron content, has greater brilliancy and more refractive power, after being silvered, than glass made from iron free sand. A simple, satisfactory batch for thermos bottle glass is the following:

Martinroda sand	100 k. g.[1]
Soda ash (98-100%)	32 "
Lime	21.8 "

If this batch is too hard to melt, the lime can be lowered to 18.6 k. g. In any case the glass is sufficiently resistant against heat and chemical action. It is a serious mistake that often little attention is paid to the chemical composition of the glass intended for thermos bottles. Consequently it happens that whole shipments of bottles crack at the neck. For such an occurence it is the glass manufacturer who is to blame, because he has not sufficiently watched his workmen. Many cases of this sort can be explained from the fact that cullet of a different composition has been used. It occurs frequently that cullet or soda ash is added to the pot when the melting process is slow during the night. Careful control at all times is necessary, checked up occasionally by chemical analyses of the glass and a comparison of the result with the composition of the batch. Of equal importance is the blowing of the inner and outer flasks. When the flasks are too thin or too heavy, the thermos bottles made from such parts are not resistant against shock, no matter how good the composition of the batch is. In such a case also, the manufacturer is to blame.

Poor annealing gives a poor quality of bottles which is quite easily explained. If a white deposit occurs after drawing out the bottom and the neck, the bottle can be considered to be of good quality and will cause no trouble during the process of making a thermos bottle.

The inner and outer flasks, made in the glass house are sent to the glass blowing shop for further working. Here they are cracked off, the outside flasks from the mouthpiece and bottom, the inside only from the mouthpiece. Here the workers should not be changed often, and one can be considered fortunate to have a well-trained workman, even if he is expensive. If a new man is to learn the work it is important to see to it that no adjustments are made on the machinery.

The bottles must be well cut with a diamond. The flame should not be too wide, but should be long. The inner and outer flasks are usually put in boxes. It often occurs that water enters the boxes and moistens the excelsior. If such a box comes to the workmen and if newly cracked off flasks are put on the damp excelsior a number of small cracks are formed, which show clearly when the neck and bottom are made. It often happens that a crack is enlarged and a bottle must be discarded. It is important to watch the length of the neck. That of the inside flask must be at least 4-5 mm. longer than the neck of the outside one. After the cracking-off process, the flasks must be free from all dirt. The inside flask should be wiped with a cloth, the outside one must be washed with distilled water.

The inside bottle is then placed into the outside one, and kept in place with spirals or with asbestos. Opinions are divided as to these two methods, asbestos being generally preferred by the majority of manufacturers. The spirals

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†Glass Technologist, Deesbach, Thuringen.
[1]Approximate composition of this glass is as follows:

Silica	71.17%
Calcium oxide	15.52%
Sodium oxide	13.31%

EDITOR.]

are decidedly less practical, but they have the advantage that no spots remain in the bottle which are not covered with the silver deposit. They also do not retain moisture. But they have many disadvantages, for instance, if spirals are not placed exactly straight, and if one is a little longer than the other, the ends of the inner and outer flasks are pushed apart, and the slightest shock causes cracks, or even whole pieces fly off. In such cases up to 22 per cent breakage may occur. If the spirals are too strong or too large, the walls of the outer flask are often broken through. In order to escape these difficulties to some extent, five spirals are used instead of three. As a rule spirals are only used when especially desired. They are demanded principally by American dealers, and in order to obtain the business the manufacturer is obliged to comply with the specifications. Asbestos does not have these disadvantages. It can be pushed in easily, without breaking the bottle and the whole method is more economical. Manufacturers who make their own asbestos rolls obtain thereby a considerable quantity of waste material which can be utilized by mixing it with a little water to a paste which is used to cover the inside of the cooling vessels.

The bottle is now passed to a workman who places it in a container which forms part of a small machine. The container is lined with asbestos. The edge of the bottom is softened by means of a blast lamp. The softened glass is grasped with a pair of tweezers and drawn out. Air is blown into the bottle through a hole leading through the container, in order to give the desired shape to the bottom of the bottle. The bottle is then taken out of the container and a capillary glass tube is melted into the bottom. This tube serves to introduce the silvering solution, to blow air into the bottle in order to form the neck and for the evacuation of the air. The capillary tube is inserted after first softening a small space on the bottom which is blown out by compressed air, entering through the neck. This place and the tube are heated together, after which air is blown in from the neck and the tube is drawn out slightly.

Now follows the fashioning of the neck. The bottle is again placed in the container but this time with the bottom downward. The two necks, of the inner and outer flasks are softened and brought together. Air is blown in to prevent the glass from becoming too heavy at this juncture, which would cause cracking on cooling or when the bottle is exhausted. During this operation a cooling vessel, made of sheet iron and lined with asbestos is heated to a red heat. It serves to receive the bottle and allows it to cool gradually to prevent breakage. The bottle is then ready to be silvered. The silver solution is introduced through the tube and the bottle is kept in motion by means of machinery having wooden rollers. In order to speed up the silvering process the temperature may be raised by means of glass flames, but should not exceed 35° C. This has some disadvantages, however, since the wooden rollers often become warped by the heat. It is better to keep the silver solution at the proper temperature by means of a small gas flame. The silvering solution can be made in several ways; almost every factory has its own formula which is kept secret.

When the bottle has the desired coating of silver it must be freed from sediment and water. This is done by air pressure. The sediment is usually thrown away and almost everywhere the used silver solution and sediment are discarded. The sediment can be changed to silver nitrate again. The solution frequently still contains silver. This can be tested for by acidifying with nitric acid and addition of hydrochloric acid. If silver is present a white precipitate of silver chloride is formed, which can be utilized again.

The bottle is dried to remove the moisture. A number of suitable drying racks have been built for this purpose, for instance a cabinet made of sheet iron, having a number of small compartments in which the bottles can be placed in iron boxes. Sheet iron boxes with wire gauze bottoms are also used. When the bottle is dry the capillary tube must be freed from the silver deposited on the walls. This is done with nitric acid. The tube is often cleaned before drying the bottle, which is the better procedure.

The bottle must then be evacuated, which is done in different ways by means of various sorts of pumps which cannot be described here. The most important thing is to avoid leaks in the connecting tube, which is usually made of glass. Phosphorus is still used in some pumps, but this substance has been eliminated in those of more recent date. Whether the bottles are free from air, and the presence of leaks may be tested for with a mercury gauge. Small leaks often occur, for this reason great care should be exercised in the melting together of the necks and the introduction of the capillary tube, to avoid the formation of slight cracks and bubbles at the points of junction. All such defects show themselves during evacuation. If the gauge shows the desired vacuum the bottle is closed by fusing of the capillary tube. This must be done very carefully, the glass must be heated gradually at first to avoid cracking. Too strong a flame may cause the bottle to become leaky. In this case the air enters and all the other bottles on the line must be evacuated again.

The bottles can now be tested. For this purpose they are filled with water of 95° C. and allowed to stand 24 hours. Those bottles which still maintain a temperature of 45° C. can be considered satisfactory. The others, which do not show this temperature must again be evacuated and tested. The bottles are then put into holders and are ready for shipment.

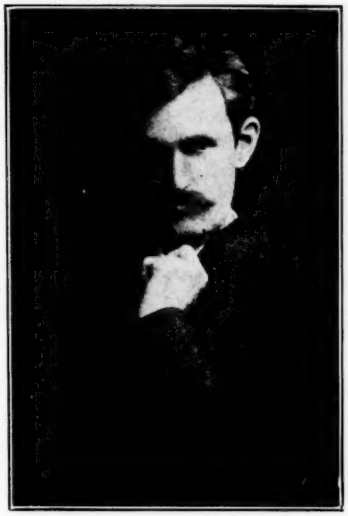
Another New Use for Glass

In a paper presented at a recent meeting of the American Institute of Chemical Engineers, the use of glass rings as a filling material in fractionating columns in chemical plants was discussed by F. C. Teisberg, chemical engineer of the du Pont Company. The qualities desirable in a packing material are described, the inherent faults of metal and earthenware rings as used at present were pointed out and the advantages of glass rings set forth. The du Pont Company is using glass rings with notable success in several distilling operations and after much experimenting in their manufacture, is now making the rings commercially and offering them in several sizes to the trade. A cubic foot of the smallest rings, size 4, contains 369,000 rings, weighs 52 pounds and is offered at the price of $115. The largest size, 12, runs to the number of 13,650 per cubic foot, which weighs 29.1 pounds and sells for $13.

Heat Resisting Glasses*

Professor W. E. S. Turner, O.B.E., D.Sc., F. Inst. P., read an important and interesting paper on the subject of heat resisting glasses at the Royal Society of Arts, on February 28, before a highly appreciative audience.

Dr. Turner remarked at the outset that power to resist sudden changes of temperature was not a property normally associated with glass. The occasional cracking of thick tumblers when hot liquids were poured into them was a reminder that ordinary glass was not an ideal heat resister. The first and probably the most widely understood cause of the tendency to fracture on heating was the low thermal conductivity of heat; so that, on heating it, the slow flow of heat across its walls resulted in great tension on the colder layers not exposed to the sources of heat, due to differential expansion. Relative conductivity for heat alone did not entirely account for the fracture.



PROFESSOR W. E. S. TURNER

Thermal endurance to denote the power of a glass to withstand thermal shock, went on Dr. Turner, was a term introduced by Winkelmann and Schott. Thermal endurance in practice might be determined by heating equal lengths of glass rods of the same diameter in an electric tube furnace to varying temperatures and determining the comparative tendency to fracture when dropped suddenly into cold water. Flasks and beakers were filled with molten paraffin wax heated to varying temperatures between 150° and 250° C and plunged into water at 20° C. Then ordinary heavy bottles used for beverages might be filled with water, heated in a water bath to 70° C to 85° C, and then cooled in water at 20° C.

Properties directly affecting the thermal endurance were the tensile strength, the elasticity and the co-efficient of expansion; the remaining three properties producing an effect proportionate either directly or inversely to their square roots.

Some Early Efforts

Proceeding, Dr. Turner said that in practice, so far, the attempts made to improve heat resisting power of glass had been either in the direction of increasing mechanical strength or diminishing the co-efficient of expansion. The earlier attempts had been designed to improve mechanical strength by processes of hardening or of diminishing co-efficient of expansion. Professor Turner quoted numbers of the earlier attempts designed to improve the mechanical strength by processes of hardening them, including de la Bastie's method, published about 1874; the glass being heated up to stage of softening from the heating muffle and then allowed to slide into a covered bath of hot oil made up of a mixture of oils, wax, tallow, resin, etc. That mode of treatment, it was averred, induced greater mechanical strength.

Processes of Toughening Glass

Siemens' was probably the best known by repute of the various other systems of toughening glass. The process was apparently the subjection of articles to mechanical pressure inside molds of special design either of metal or fireclay; but of the process no lucid accounts were available. O. Schott's method describing the means by which mechanical strength was made to resist thermal shock, published 1892, was the most successful. Schott showed that under certain conditions glasses of different co-efficient of expansion could be united when gathered on the blowpipe in successive layers. When a glass article was made of which the inner part had a lower co-efficient of expansion than the outer, and the article was cooled in the air, so that the outer layer exerted a compressive force, it then resembled hardened glass. Schott had a glass of this kind made up into flasks and cylinders subject to a temperature of more than 180° C, and they did not fracture when cold water was sprayed onto them. The second method, namely, that of controlling co-efficient of expansion was adopted later, and had been the subject of many successful developments in recent years. In 1892, Schott collated the existing information on thermal expansion, showing that different constitutent oxides had each a definite effect on total expansion of the glass. Then in 1893, in conjunction with Winkelmann, a more definite value was assigned to the individual oxides, and the co-efficient of expansion was found to be additive in character and capable of calculation from formula. Very little additional research had been carried out since Schott's work was published on the relationship between expansion and composition, until the last four or five years in the author's laboratories. Revision was needed in some of the two German investigators' factors. The effect of magnesia, for example, was not nearly as advantageous as the earlier factor led them to suppose; while the value of boric oxide had been found only to apply to glasses containing a limited percentage of that constituent.

Results of Research

But Schott's results had immediate application in the manufacture of heat resisting glasses. Thermometer glasses of low depression constant and fairly low expansion represented one type. The Jena chemical glassware constituted another; and, indeed, practically all modern glasses used for chemical ware were not only resistant to corrosion, but also in various degrees heat resisting. Silica and boric oxide, for instance, increased the resistance, particularly to water and acids, as well as diminishing the co-efficient of expansion. A table of expansion factors set out by the author purported to show that two oxides in particular, namely, silica and boric oxide, were associated with small expansion; while another

*The Pottery and Glass Record, Vol. 5, No. 5, 1923.

table showing analysis of six types of heat resisting glasses showed the extent to which these two oxides were used in modern times. In the case of the well-known combustion glass made by Messrs. Kavalier, silica was the most important constituent, reaching the very high value of more than 79 per cent; and successful combustion tubing made in England possessed also a very high silica content. Boric oxide was not present in Kavalier's tubing, and the basic oxides used as fluxes, namely, potash and lime, prevented the production of a low expansion glass. On the other hand modern glasses contained boric oxide in very considerable amount. Pyrex glass, the most notable of glasses in recent years, contained roughly 80 per cent silica and 12 per cent boric oxide; and there was a tendency in manufacture both of chemical and of heat resisting glassware, to make them strongly acid in character; since the acid oxides, silica and boric oxide, were far superior to the basic oxides in giving low expansion. The use of silica and boric oxide beyond a certain limit was attended by certain difficulties in practice. In silica the difficulty was merely that of attaining a sufficiently high temperature. Fused quartz and semi-fused vitreosil were now well-known; they had been used for a variety of scientific apparatus and within the last few years vitreosil lamp chimneys had had a considerable demand.

NEED OF ELECTRIC FURNACE

For the melting and working of such glass, however, Dr. Turner went on, the electric furnace was needed; and the mode of manufacture necessarily differed from that to which the ordinary glass manufacturer was accustomed. Naturally, also, while sand or powdered silica was cheap, the energy consumed in reaching the necessary temperature for fusion was expensive. Boric oxide, on the other hand, and borates in general, fused readily, and both borax and boric acid, had been used in the glass industry for a long period as fluxes. The combination of low expansion and ready fusion was a fortunate one. There were, however, certain drawbacks to the use of boric oxide beyond a certain limit in glass. In the *Journal of the Society of Chemical Industry* for 1916 Sullivan and Taylor, giving an account of the development of Pyrex glass, stated that they were forced to limit the amount of boric oxide because of the diminished durability of the glasses produced when a large amount of boric oxide was present. It had been and was still generally believed that the introduction of boric oxide into silicate glasses greatly improved the power of glass to withstand action of water and acids. This was not true without qualification, however. It was pointed out in a paper written some years ago by the Department of Glass Technology that boric oxide beyond a certain amount was of very doubtful advantage. Recently, systematic investigations in the Department of Glass Technology, Sheffield, had shown that on addition of boric oxide to a glass composed of silica, boric oxide and soda, the amount of the latter being kept constant, the durability rose to a maximum and then rapidly diminished, a fact brought out very definitely in one of the illustrations given by the author of the paper, wherein the percentage of sodium oxide extracted from the glass on boiling the latter in the state of powder of 20 to 30 mesh for one hour was plotted against the boric oxide content of the glass. Therefrom there is seen at first a rapid improvement in durability, but the maximum was reached for this particular glass somewhere in the neighborhood of 11 to 12 per cent of B_2O_3. Thereafter, the durability rapidly diminished, until when 40 or more per cent of boric oxide was present, the glass rapidly broke up, more rapidly indeed, than did sodium silicate. That fact alone rendered glasses of high boric oxide incapable of ordinary use; but equally important from the standpoint of heat resisting glasses was the fact that the reduction in the co-efficient of expansion occurring on introducing boric oxide was also limited to a certain range, and when the range was exceeded, the co-efficient of expansion once more increased. In other words, there was a certain minimum value of thermal expansion obtained by the use of boric oxide, and beyond that the expansion increased. A second illustration presented by the author represented graphically results recently obtained at Sheffield for two series of glasses; one with approximately 20 per cent Na_2O, the other with 10 per cent Na_2O, the silica in each being gradually replaced by boric oxide. The figure indicated that the minimum co-efficient of expansion was reached in both glasses at approximately 20 per cent of boric oxide.

THE HANDMAIDEN OF ART

Continuing, Professor Turner said that it would be understood that whereas the only factor limiting use of still higher proportions of silica in glass was the design of a very high temperature furnace with refractory materials better than fireclay; on the other hand, the boric oxide had its limitations, because after a certain concentration had been reached, not only did the glass become unstable, but also the expansion increased. Nevertheless, by combining these two oxides in boro-silicate glasses big advances in the industrial arts had been made possible. They were already well acquainted with the Jena factory productions. In recent years, the chemical and scientific glass industry had also been built up in England, and all the chemical glassware made had been of the boro-silicate type. Miners' lamp glasses were only produced in this country after the outbreak of war, and the glass again was composed mainly of silica and boric oxide, when analyzed. In addition, other types of illuminating glasses, lamp chimneys, etc., were being made from glass similar to that used for miners' lamps. Specimens of such glasses were included in the exhibit being shown by Messrs. Chance Bros., and Messrs. Ackroyd and Best.

NEW DEVELOPMENTS IN GLASS MAKING

In the new development of utilizing glass for baking and cooking dishes it was the Corning Glass Company, of the United States, that led the way, and the development had already assumed big proportions. In this country Messrs. Ackroyd and Best were making cooking ware, and the manufacture in Great Britain was likely to be extended. The Corning Glass Company was now making teapots of Pyrex glass and feeding bottles, and the H. C. Fry Company had recently introduced tea cups of the same glass as they employed for ovenware.

UNBREAKABLE GLASS

Dr. Turner touched upon the reported discovery in Czecho-Slovakia in the earlier part of last year of unbreakable

glass. During last summer, Dr. Turner proceeded, it was his privilege to visit the factories whereat the so-called unbreakable glass was being developed. The proprietors, Messrs. Kavalier, stated however that the sensational statements made did not meet with their approval, and because of them the glass was being withheld from the market until its properties could be tested scientifically, and an authoritative report obtained. He (Dr. Turner) had received from Messrs. Kavalier a copy of the report, by Professor Hac, of the University of Prague. There was one avenue down which investigators might press with assurance in an endeavor to peep into the future and forecast possible developments; while others were tempting. In the first place, they already were familiar with the valuable properties of fused silica, and the problem, already indicated, was to discover refractory materials which would withstand action of fused silica, with or without small additions of other oxides at temperatures of 1,550° to 1,750°. Pyrex glass was melted in tank furnaces operating at a temperature not less than 1,500°, so that notable advance had been made regarding high temperatures in the glass industry. Open hearth steel furnaces were operated at temperatures considerably higher still, so that no difficulty was likely to be experienced in proceeding to a further stage when once the suitable furnace material was forthcoming.

Oxides and Resistance Qualities

So far as the use of other oxides was concerned, continued Dr. Turner, the field was not exhausted. Zirconia, for example, had a linear expansion co-efficient of 8.4 x 10-7, only little inferior to fused silica; but with a melting point of about 2,000° C, clearly this oxide was first likely to find use, not in the pure fused state, but as an addition to silica. The same was true of other refractory oxides, such as titania and thoria. Already some preliminary attempts had been made to produce glasses by adding small amounts of titania and zirconia to silica, the objects being to increase resistance of the fused silica to devitrification and to attack by basic materials. The general results stated to be achieved were the production of a glass having superior mechanical properties and thermal properties to vitreosil, although actual numerical data had not been quoted.

Other experiments had undoubtedly been made in factories with glasses containing a series of oxides, including titania, to test specific points, but information was not forthcoming, and perhaps not obtainable, of the effect on thermal expansion. At Sheffield it had been found possible to add both zirconia and titania to ordinary glasses, and it was hoped very shortly to be able to announce the effect on their properties. It might be noted that when several per cent of titania was present, small crucibles of glass could be cooled down without special precautions to yield unbroken lumps. That indicated either a reduced thermal expansion or an increased mechanical strength; in any case, an improved heat resisting glass. He averred that given the requisite optical properties, it was conceivable that the addition of either zirconia or titania to optical glass might make it possible to obtain a bigger yield of glass from an optical glass melting by reducing the amount of splintering. In the presence of reducing gases, unfortunately, titania glass tended to be dark brown in color, although it was possible to retard such color development.

Possibility of Heat Treatment

Concluding, Dr. Turner said that regarding the possibility of heat treatment, it had to be remembered that until devitrification set in, glass contained no crystalline structure the units of which could have their boundaries modified, as was possible in metals, by cold working or by heat treatment. Owing to its brittleness, glass hardened by quenching possessed an element of risk, as, when the outer layers were broken through, the mass was at once reduced to powder.

Grading Polished Plate Mirrors

The revised rules of the Mirror Manufacturers' Association issued by H. C. Sorden, secretary, Shelbyville, Ind., for grading polished plate mirrors are as follows:

First Quality Mirror

This quality is made from a selected grade of plate glass and such defects as fine scattered seeds and small, faint hair-lines will be permitted.

Second Quality Mirror

This quality is made from not quite as carefully selected grade of plate glass as first quality, and the defects enumerated in the first quality and in addition thereto more seeds, occasional small bubbles, and more scratches, when not grouped, will be permitted.

Third Quality or Commercial Quality

This grade is made from the ordinary glazing quality plate glass, and is not subject to rejection for any of the inherent defects in plate glass, except open shot holes and fire cracks.

Defects

The following is an outline or description of the various inherent defects in plate glass to be used as a guide to manufacturers, purchasers or inspectors in determining quality or grade of mirrors.

Bubbles—Gas inclusions generally spherical and brilliant in appearance and larger than (4mm.) .015 inch in diameter.

Seeds—Minute bubbles smaller than (4mm.) .015 inch in diameter, visible only on close inspection, and are an inherent defect in the best quality of plate glass.

Shot Holes—Bubbles which have been broken into by grinding, leaving a hemispherical hole in the glass surface.

Feathers—Streaks or areas of finely divided opaque foreign material mixed with numerous small bubbles or seeds. Appears as a mass of specks due to the inclusion of foreign material, usually unmelted batch or incomplete skimming of pot before pouring.

Strings—Light, wavy, transparent lines on the surface appearing as though a thread of glass had been partially incorporated into the sheet.

Ream—A patch of area of strings or cords. An area of non-homogeneous glass incorporated in the sheet appearing as a knotty, hairy mass mixed with the clear glass.

Scratches—Any marking or tearing of the surface, appearing as though it had been done by either a sharp or rough instrument.

Short Finish—Poor polish, lack of smoothness or improperly finished surface which has the appearance of being slightly pitted and wavy when the surface is viewed in reflected light.

Stones—Any opaque or partially melted particle of rock, clay or batch ingredient imbedded in the glass.

Lines—Waves which extend across the sheet such that the reflection from the surface appears as a line or a series of lines.

Fire Cracks—Small cracks penetrating the surface of the sheet. Usually in the shape of short hooked crescents. Caused by sudden heating or chilling of the surface.

Glass-Forming Machines*

A very complete description of the principles of various glass-manufacturing machines and the methods employed in the production of various types of glassware was given in a paper read before the Junior Institution of Engineers, in London, on March 2, by Mr. C. Saxton.

Dealing first with bottle manufacture by hand, Mr. Saxton briefly described the method; then traced the development of mechanical methods of bottle-making from 1886, when Ashley took out the first patent for a mechanical method.

The adoption of compressed air for the blowing of bottles and early methods of mechanical manufacture were described. Coming down to modern equipment, a number of types were shown on slides and the operation of the O'Neill machine was described in order to enable the operation of other machines of somewhat similar type to be understood.

Mechanical devices having reduced the labor required to operate the machine to one gatherer, the next step was to eliminate this man and pour the molten glass directly into the parison mold. Hundreds of patents have been taken out for this purpose, and there are at least ten or twelve different types in operation which are giving more or less good results. There are very many difficulties to be overcome and conditions to be fulfilled in the design and construction of an efficient "feeder," among which may be noted: (1) The weight of glass fed for each bottle must be constant for a given bottle; (2) it must be possible easily and quickly to change the weight delivered when it is desired to make a different kind or size of bottle; (3) it must be possible to stop the flow of glass for a short period, as, for instance, when adjusting the machine, and start again without any delay due to the glass freezing up in the feeder; (4) it must be possible to vary within wide limits both the speed of and the weight of glass delivered by the feeder; (5) it must be possible to control and vary within very wide limits the shape of the mass of glass delivered, in order that it may be made to approximate as closely as possible to the shape of the parison mold. Although all manufacturers of feeders claim to be able to fulfill these conditions, there are only one or two makes, said the author, which actually do so.

Among the practical difficulties to be overcome is the fact that the viscosity of the glass varies greatly with the temperature and composition, so that if a feeder is operating at correct weight and the temperature of the glass falls, the weight of glass delivered in the same time will also be reduced, and *vice versa*. Attempts are made to control this temperature by the use of auxiliary gas or oil burners. Another trouble is the cutting of the stream of molten glass into separate lumps, and, after cutting, to hold up the stream until the lump just cut off has arrived in the mold and thus cleared the way for the next one. Here the trouble is due to the fact that the molten glass is rapidly chilled on the surface, and falls into the mold in a series of coils or folds, the chilled surfaces showing in the finished bottle as veinlike creases and marks, or else air is entrapped in the folds, which results in blisters, etc. In the earlier type of feeders attempts were made to imitate mechanically the hand method of gathering by plunging a rod into the glass and giving it a twirling motion, then allowing the glass so gathered to fall off the rod into the parison mold. Other types were developed in which a continuous stream of glass was allowed to flow from a small extension of the furnace. After leaving the furnace, the stream was broken up into lumps or charges suitable for entering the parison mold. Various methods were used to effect this result, including the use of cup-shaped shears, which, after cutting the stream, collected the still flowing glass and then opened and closed quickly, allowing the glass collected to fall into the mold, cutting the stream and repeating the operation. In another type, after the glass was cut by the shears the stream was held up by a blast of gas, and yet another method was to draw the glass back into the tank by suction after cutting the stream. All these methods, however, possessed defects, and the next development was the adoption of the "propulsion" system of feeding, i.e., instead of allowing the glass to run out of the furnace by gravity in the form of a stream, means were devised for forcing the glass from an extension of the furnace, from which it could not otherwise escape. The majority used a fireclay plunger, which was placed upright in the extension of the furnace, above a hole in the bottom of the extension. This plunger was given a rise and fall motion, usually by attaching it directly to the piston of an air cylinder. Thus, when the plunger was lowered, the glass was forced out of the hole, and, on raising the plunger, the flow of glass stopped. In another type a fireclay paddle was used to propel periodically a wave of glass over a fireclay dam into a small auxiliary chamber, from which its flow was controlled by a needle plunger. By varying the stroke and depth of immersion of the paddle the weight of glass washed over could be controlled within very fine limits. The plunger controlled the shape of the gob of falling glass. Slides were given of the Hartford-Fairmont paddle and needle, and of the Rankin feeder, this latter in the author's opinion being one of the best of the type in which the glass is forcibly expelled by a plunger.

The author then dealt with the evolution of the Owens machine, a number of which are in operation at the Charlton works of the United Glass Bottle Manufacturers, Ltd. This machine employs entirely different principles from those already described, and slides illustrated how, from the most simple and crude methods, a machine has been evolved which may be truthfully described as almost uncanny in the accuracy of its operation, and which represents, the author said, the highest degree of perfection yet reached in the mass production of bottles.

Dealing with sheet or window glass, the author said that at least 99 per cent of the glass in windows at the present time in this country was blown in the form of a cylinder and then flattened. Slides were shown depicting the process of manufacture.

Among the most successful attempts to make the sheet of glass direct instead of making cylinders and flattening them

*Abstract from report in *The Pottery Gazette and Glass Trade Review*, April 2, 1923.

(in fact it might be said that they are the only ones that have been developed to a really practical and commercial stage) are the Libbey-Owens and the Fourcault systems. The Fourcault method is a combination of the flowing and drawing processes, and Mr. Saxton illustrated this by means of a diagram. A fireclay block or debiteuse is immersed in molten glass, and the glass flows naturally upwards through a slot, and then passes between pairs of rollers. Immediately below the first pair of rollers are two water-cooled tubes, for the purpose of chilling the surfaces of the sheet so that, in passing through the rollers, it is not marked by any slight inequalities which may occur on the rollers; at the same time, by cooling the surfaces before they come into contact with any object, the fire polish is preserved. The rollers are contained in a vertical duct about 20 feet high, built up of cast iron plates at the lower end and steel plates at the top, the duct being provided with suitable baffle plates, which serve the double purpose of catching any glass which breaks and falls, and also preventing the ingress of cold air, ensuring that the sheet of glass is cooled gradually in its passage upwards. The rollers are carried in bearings attached to the outside of the duct, all those on one side being fixed, while the others are attached to the one end of a bell crank lever fitted with counter weights in such a manner that there is always sufficient pressure on the sheet as it passes through the rolls to cause it to be carried forward. The pressure is small, as the weight of glass lifted by each pair of rolls is only that of the glass between each successive pair, usually about 12 inches, the width of the sheet being 4 feet 3 inches. Each pair of rolls is geared together by means of pinions with specially long teeth, but only the rolls on one side are positively driven. The drive is by means of bevel gears from a vertical shaft, which in turn is driven through suitable reduction gearing by a 3-horsepower variable speed motor, the actual speed of the rolls being:

For 15-ounce sheet ..... 1.5 r.p.m.
For 21-ounce sheet ..... 0.6 r.p.m.

which gives 8 square feet, 15 ounces per minute; after trimming, 3.25 square feet, 21 ounces per minute.

When the sheet arrives at the top of the duct it is cut off in suitable lengths, and trimmed and cut into commercial sizes in the cutting-room.

Standard modern methods of making plate glass were described and reference made also to the Ford Motor Company's new process. In the course of the discussion following the presentation of Mr. Saxton's paper, Mr. Clark spoke, stating that he had been connected with the glass industry for over thirty years; in the early stages he had been concerned mostly with the making of electric lamp bulbs, and in those days there were also press molds for making the old abomination of shades. The machinery in use at the present time represented a marvelous development. In making electric lamps they were dealing with glass about 1/100th of an inch thick, and they could not use the same raw material as in the case of the average bottle. The electric lamp glass had different properties from the bottle glass, and had to pass very rigid tests with regard to clearness and coefficient of expansion, which latter must accord with the wires of the lamp. With regard to the use of nichrome for molds, a great number of molds are made of nichrome at the present time. This material was a nickel-chrome alloy with marvelous heat-resisting properties, and it had also been found to be very useful when used for the ends of blow irons. In the olden days a set of blow irons would probably last a week, but now they could be made to last for two or three years if the proper grade of nichrome were used. That was very important, because the supply of blow irons constituted a very heavy overhead charge in some of the hand-made glass works. Recently he had seen a large number of molds made of nichrome, and he had been told that with some of the later varieties, by changing the alloy slightly, the makers were able to produce a metal with a skin equal to that of the very highest polished steel. There was no doubt that in the future nichrome would be used on a much larger scale than it is at present.

Mr. W. Farmer said that, being engaged in the glass bottle industry, the lecture had been most interesting and instructive to him. There was very little lecturing on this subject, and that, coupled with the fact that glass bottle manufacturers were a very conservative crowd and lived like hermits—they would not tell each other what they were doing—made it very difficult for a young engineer to make any progress at all. With regard to the Hartford-Fairmont feeder, reference had been made to the limits of accuracy within which this could operate; it could be accurate to within ¼ ounce. Again, Lynch machines had been adapted to make screw-threaded jars, and the efficiency of the Lynch machines was extremely good. His firm were getting, on three of those machines, an average efficiency of 90 per cent, and when it was considered that the machines turned out about 300,000 bottles from Sunday night to Saturday midday, it would be agreed that that was a good performance. With regard to getting an accurate weight of bottle, his firm had been making milk bottles on another machine, and some quart bottles were returned because they were 1/80th inaccurate in size. He would like the author's opinion on the question of how automatic machines had been received in glass works. Speaking generally, he himself believed that the old-fashioned glass maker did not like the intrusion of machines into his factory. The position was much the same in regard to some of the foundries in this country about ten years ago, when molding machines were first brought into use, but fortunately that spirit had been lived down in the foundries. In the glass bottle trade, however, we were experiencing that trouble at the present time. He also asked for the author's opinion as to the suitability of the Owens machine for work in this country. It seemed all very well in a country where large outputs were required and they could always get rid of their products, but with small orders it seemed that the only thing to do was to make stock.

Mr. Saxton, dealing with the question of the use of automatic machines in the glass industry, said he believed that in very many cases the works owners had been willing to install them, but the men had not. He was at a factory only that week where two machines were started up, and as soon as they were started a union official intervened and stopped the shop. Mr. Farmer said that in one case someone had put a piece of brick into the machine and stopped it for several hours.

Mr. Saxton, replying with regard to the use of Owens machines for small orders, pointed out that with the 10-arm machine ten different types of bottle could be made, so that, although the total production was huge, it could be divided into ten smaller lots, which enabled them to compete for the smaller orders. If the Owens machine could only make one type of bottle at one time, orders running into hundreds of thousands would be necessary. Mr. Farmer asked how long it took to set the machine up. Mr. Saxton replied that that depended on the machine, the molds and the crew. Mr. Basotti said that the setting-up occupied two hours.

Mr. R. H. Parsons, dealing with the question of large versus small orders, said a lot of people thought that because the United States was a big country the orders there were about one hundred times as big as those obtained here. As a matter of fact, the United States had only about double our own population, so that, on an arithmetical basis, their orders should only be twice as large as ours. If we were as enterprising as the manufacturers of other countries our orders would be as big; our manufacturers did not lay themselves out to get the orders. This was a little country with a very big population, and he believed there was as much room for manufacturing on a large scale here as anywhere else. One reason why we did not get large orders was because glassware was imported from Belgium. Belgium was a small country, with a small population, but they laid themselves out to secure orders.

Mr. Saxton said that in this country orders were distributed to different factories according to size. An order of, say, 15 gross would be sent to a small factory, whereas big orders would go to the big factories. Dealing with the use of nichrome, he said he had used it for ring molds and plungers, and had obtained extremely good results.

Employment Contracts Involving Inventive Service*

By Lloyd Van Doren†

Whether an employer is entitled to an interest in an invention made by an employee is a determination which not infrequently must be made, and various considerations enter into such a determination. An inventor, when accepting employment in which he will exercise his inventive genius, should realize that certain obligations inhere to his efforts with respect to the rights of his employer, and it is therefore desirable that a special contract covering his services should be arranged, which will set forth distinctly the respective rights of his employer and himself in any inventions which the latter may make.

These contracts should not be inadvisedly entered into, as an inventor may find himself to be indefinitely restrained from operating in the field of his experience. Accordingly, all such contracts should be carefully considered, and frequently it may be found desirable to decline to enter into them. However, a great loss may entail when an employer finds himself despoiled of important inventions developed in his works and at his expense. This is a common result of the service of unfaithful employees and warrants the employer, when availing himself of inventing services, to secure himself by fairly rigid contracts, which contracts may be said to have tended to prejudice, rather than to promote, the interests of inventors. If it were a more prevalent desire on the part of inventors to give the full result of the employment to the one who is paying for it many unfortunate contracts might be avoided.

It is one thing to produce inventions in an employer's time, and another to do creative work in the employee's time. When the inventing is in a different field from the employer's business, or is not the regular work for which an employee has been retained, it is not difficult to draw a line of distinction as to the ownership of patent rights. When such are not the cases, the line to be drawn is more difficult. In the cases mentioned, the rights of the inventor are pre-eminent; in other cases a determination must be made, in view of all the conditions and facts surrounding the employment and the making of the invention, in order to determine the relative interests of inventor and employer.

In early times, when communication was difficult between people, between portions of a country, and between nations, the field of usefulness of a person in his employment was considerably restricted. During such times the courts did not view with favor agreements limiting territorially the right of a man to pursue his occupation or vocation. By so doing, the ability of a person to earn his bread and butter might be circumscribed, something which is clearly against public policy.

In this age, however, where agreements are entered into, embodying restrictions as to time and territory, involving the pursuit of an occupation, in matters arising out of contracts of invention and employment, the tendency of the courts today is to sustain such restrictions where they are reasonable. If this were not true, a person could enter the employ of a manufacturer, obtain wages based upon his inventive capacity and the value of the inventions which he might produce and intended to be owned by the employer, obtain knowledge of trade secrets, or special efficient methods of the employer, and after a certain time separate from this employment, taking with him inventions and methods to competitors.

When agreements are made in good faith in limitation of the extent to which an employee may proceed along the above lines, it is the view of the authorities that contracts of employment restricting the employee should be sustained, the reasonableness of the contract being, of course, always a question of importance. So it is that while a court may in some cases restrict an employee from entering a competing business for a period of two years, such a restriction for ten years might be deemed wholly unreasonable. When phases of coercion enter into the circumstances of the contract, and where an employer seeks to take an undue advantage of an employee under such contracts, the extent to which courts will go in sustaining an agreement may be considerably limited.

Chemical Age, December, 1922.
†Consulting chemist; patent attorney; Duell, Warfield & Duell.

Decolorizing Boro-Silicate Glasses

A United States patent has been issued to William Chittenden Taylor and assigned by him to the Corning Glass Works, Corning, N. Y., covering a method for coloring low expansion boro-silicate glasses pink or for decolorizing them. The following information is taken from the patent specification:

Various agents, including manganese dioxide, nickel oxide and selenium, have been added to glasses. In all ordinary glasses one or the other of these agents will produce a pink color, and if used in sufficiently small quantities will, while not coloring the glass, effectively neutralize the green tint due to the presence of small quantities of oxide of iron in the glass, and thus deprive the latter of distinctive color.

If, however, the glass is acidic, such as are the low expansion boro-silicate glasses, none of the above named agents can be used effectively, either for coloring the glass pink or for decolorizing it, as with such glasses these agents tend to produce, not a pink, but a color varying from yellow to dull amber.

The color produced by oxide of iron, in acidic boro-silicate glasses is yellow, whereas in ordinary glasses it is green. Thus manganese oxide, nickel oxide and selenium, so effective in neutralizing the green tint of ordinary glasses, only intensify the yellow, making the glass more of an amber. I have discovered, however, that neodymium oxide (Nd_2O_3) can be used effectively for decolorizing low expansion boro-silicate glasses. Neodymium oxide, which produces a lilac hue in ordinary glasses, is not effective there as a decolorizer, because its chief absorption band is in the yellow, and it only neutralizes green when present in too great a concentration for the ordinary clear glass. Unlike manganese oxide, nickel oxide, and selenium, the hue produced by neodymium oxide is not uniformly changed in boro-silicate glasses, and due to its peculiar absorption of the yellow and its tendency to a flesh tint in deep layers it is quite well suited to decolorize such glasses.

The acidity of the glass above referred to may be due to several causes, including the presence and proportion therein of acid oxides (i. e. SiO_2 and B_2O_3), as modified by the percentage of alkaline ingredients (i. e., Na_2O, K_2O, Li_2O). The presence of oxides of the second group of the periodic elements (i. e., magnesium calcium, barium) as well as of oxides of lead, also tend to reduce acidity, although not as strongly as the alkaline oxides. As examples of glasses, to which this invention may be employed, the following compositions thereof are given:

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
	%	%	%	%	%	%	%	%	%	%	%	%	%
SiO_2	70	70	60	60	80	85	90	61	70	80.6	80.9	90	90
B_2O_3	24	15	20	30	6	5	2	11	20	13	12.9	6	5
Na_2O	5	15	10	10	12	10	8	8¼	4	4.4	4.4	3	..
Al_2O_3	1	..	10	..	2	..	..	6¾	6	2	1.8	1	2
PbO	..	..	..	..	..	..	..	13	..	..	..	..	..
Li_2O	....	..	..	..	..	..	..	....	..	..	..	..	3

It will be understood that in lieu of the Na_2O of the above formula, other alkali oxides (i. e., K_2O, or Li_2O) may be used, and that in lieu of the Al_2O_3 or PbO basic oxides ordinarily used in glass (such as those of the second group of the periodic system, or of lead) may be substituted. It is to be noted that antimony oxide (Sb_2O_3) should not be present in large amount as it prevents the desired action of the neodymium oxide, and the same is believed to be true of the other oxides of fifth group of the periodic system. Small amounts, however, of arsenic or antimony may be used without injurious effect.

It is difficult to obtain neodymium oxide in a state of purity, but the invention may be carried out by using what is commercially known as "didymium oxide," which is a mixture of neodymium oxide and lanthanum oxide or any material containing neodymium oxide, mixed with other substances, whose coloring action does not interfere with the coloring action of the neodymium, or, whose presence does not destroy the acid character of the glass and which is otherwise unobjectionable.

A small percentage of neodymium oxide (say from ½ to 1 per cent) added to the batch for melting any of the above glasses is effective for decoloring, and it has been found advisable to use an oxidizing batch (such as one containing a small amount of $NaNO_3$) as the color produced by neodymium is more nearly complementary to that produced by oxidized iron than produced by reduced iron.

If it is desired to produce a pink color, the amount of neodymium oxide may be increased, say, to 5 per cent, with a corresponding decrease in the percentage of the other ingredients of the above compositions. However, neodymium oxide may be substituted for an equal percentage of silica in all of the above formulæ, except that the amount which may be substituted is limited to less than 5 per cent in some cases by the nature of the glass.

With such substitution, the percentage composition of glass II becomes—

SiO_2 ..... 65%
B_2O_3 ..... 15%
Na_2O_3 ..... 15%
Nd_2O_3 ..... 5%

Generally speaking, boro-silicate glasses sufficiently acidic to give the above described coloring to neodymium oxide when such oxide replaces a part of the silica, or to give the desired decolorizing thereby, will be found to conform to the following rules:

A. To contain not less than 80 per cent silica; (examples are compositions 5, 6, 7, 10, 11, 12 and 13), or

B. To contain not less than 75 per cent of silica, with a boric oxide percentage not less than 40 per cent of the constituents other than the silica; (examples are compositions 6 and 10, to 13, inclusive), or

C. To contain not less than 70 per cent of silica, with a boric oxide content not less than the alkali content; (examples are compositions 1, 2, and 8 to 13, inclusive), or, with a boric oxide content not less than 50 per cent of the total constituents other than silica, (examples are compositions 1, 2 and 9 to 13, inclusive); or

D. To contain boric oxide in an amount not less than 50 per cent of the total constituents other than the silica, (examples are 1 to 4, inclusive, 6 and 9 to 13, inclusive).

E. To contain not less than 60 per cent of silica, and to have a boric oxide content not less than 25 per cent of the total constituents other than silica; (examples are any of the above compositions).

Standardization of Milk Bottles

A third conference of the committee on the standardization of milk bottles was held at the Bureau of Standards on March 6. A rather extended discussion of the filling point led to no conclusion, as the Milk Dealers' Association's vote was in favor of filling to the cap seat, and their representative could take no further action.

The Bureau believes that the milk dealers can be convinced of the wisdom of its recommendations if the case is put before them in a group, and it is hoped that this can be done at their next convention in September.

Resolutions were also passed recommending the use of one cap size and a limited number of bottle heights.—*Technical. Bulletin, No. 72.*

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"To Strive, To Seek, To Serve, and Not To Fail"

Solving the Arsenic Problem

Three separate investigations by government agencies, the United States Department of Agriculture, the Geological Survey and the Federal Trade Commission have failed to find conclusive evidence of unlawful methods to increase the price of arsenic and insecticides made therefrom. It is found that the increase in the southern demand for calcium arsenate to combat the ravages of the boll weevil is mainly responsible for the high price of arsenic. A shortage of this material and a further increase in price appear to be unavoidable.

Glass manufacturers may well ask themselves at this time whether they ought to continue to pay the price, whether they should look for a substitute or eliminate the use of arsenic altogether for certain grades of glass. It is very likely that a considerable quantity of arsenic is used needlessly in the glass industry for no other reason than that it always has been used in the past, when conditions may have been quite different from those prevailing now. Antimony, which resembles arsenic about as much as soda does potash, can be used successfully to replace arsenic in many instances.

Now that the cost of arsenic continues to increase it is advisable to ascertain by experiment whether the improvement due to its use cannot be attained by better attention to the composition of the batch, greater purity of the raw materials and above all, by more careful furnace management.

Arbitration of Business Disputes

During the week of May 14 to 20 commercial and trade associations, chambers of commerce, boards of trade and social and fraternal organizations of the city of New York and throughout the State will observe "Arbitration Educational Week" by uniting in an effort which aims to extend the use of arbitration in controversies and disputes where questions of fact and not of law are to be determined. It is highly desirable that this movement should be successful and that the wish to settle minor disputes by arbitration rather than by the courts may become nation-wide. It is very probable that if business men can be made to realize the advantages of this method of obtaining a settlement, there will arise a general demand for the creation of arbitration boards by which the overcrowded courts will be relieved from a large number of commercial and business lawsuits.

At the present time final decision in many court cases is not reached until from two to three years after their first record. Arbitration can settle many controversies in a few weeks or days, thus effecting a great saving of time, expense and aggravation.

The Arbitration Society of America advocates the enactment of uniform laws for all States, and places great emphasis on the need of making the decision of the arbitrator unappealable to the courts, unless in very special cases. It is certain that business and commerce will derive great benefit from a more general use of arbitration and the movement to further the work of the Arbitration Society of America deserves the support of every agency committed to the betterment of human relations.

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility THE GLASS INDUSTRY is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions are invited to submit them.

Questions should be submitted in writing and will be answered by mail as promptly as possible. The sources of all inquiries will be held in strict confidence.

Question (47)—(From England)—Stoppering Bottles.—Can you give me the American methods of stoppering bottles (chiefly Winchesters) in order to make them acid and ether proof?

Answer.—In this country bottles containing acid or ether are closed with ground glass stoppers, which are made tight by applying molten paraffin. The upper part of the neck and stopper are then covered with plaster of paris which is kept in place by a piece of cotton cloth wrapped around the plaster.—J. B. K.

Question (48)—(From India)—Government Publications on Glass.—I learn that pamphlets on various subjects are often published by the United States Government through its bureaus. How can I know what papers concerning glass and allied subjects have been published recently?

Answer.—The "Monthly Catalog of United States Public Documents," containing lists of practically all new Government publications issued each month is published by the Superintendent of Documents, Government Printing Office, Washington, D. C. The domestic subscription price for this monthly catalog is 50 cents a year; foreign subscription price, 75 cents a year, payable in advance.

The Superintendent of Documents also issues price lists by subjects of such publications issued in the past as are now available. These price lists may be obtained free of cost. A list of the publications of the Department of Commerce which are available for distribution is issued once a year and may be obtained on application to the Department at Washington, D. C. This list contains the titles and prices of the available publications of the Bureau of Standards, Bureau of Foreign and Domestic Commerce and Bureau of the Census thus covering practically all of the Government publications relating to glass.

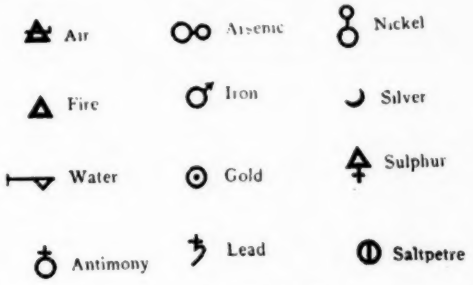
The Origin of Chemical Symbols*

By James Lewis Howe†

The one great aim of the medieval alchemist was the transmutation of metals. To his mind the different metals were but the same original substance in varying degrees of purity. Gold was the purest of all and silver followed it closely; so that his incessant labors were directed toward the discovery of some method by which the purification of the base metals could be accomplished. Vainly he sought throughout the realm of nature and in all the devices of his art for the philosopher's stone, whose touch should convert the base metals into the precious gold.

During these Dark Ages, however, the practice of alchemy was under the ban. On the one hand, the church opposed it as a black art, and its devotees were held to be in league with his satanic majesty. On the other hand, kings and councilors sought equally with the church to suppress it, since the power of manufacturing an unlimited supply of gold would, in the hands of a private individual, be much to the detriment of the coffers of the state. Yet it is but natural that many of those in high authority connived at the labors of the alchemist, that thus they might reap with him the expected profit of his success. It was indeed largely for the purpose of retaining the support of these royal patrons, that the alchemist, at heart honest in his views as to the possibility of the transmutation of metals, was led to every kind of deceit and fraud. He secretly dissolved gold in the mercury he was about to distill; by the addition of arsenic or some base metal, he whitened the gold he was about to refine, that it might appear to others to be silver; he hid gold under false bottoms to his crucibles, and by a multitude of other such contrivances fed the avaricious hopes of his adherents.

The alchemists were prolific writers, but for the sake of concealment they couched their ideas in language which was obscure to any except the initiated. This obscurity was at first doubtless due to the necessary secrecy attending their art, but, as time went on and with the dawn of a true chemistry the world became wiser, the utter lack of intelligibility in their writings was chiefly caused, as a recent author has well put it, to "a desire to appear wise where no wisdom really was." From the many books of their composition which have



been preserved to us, it would seem that much of their language must have been absolutely without meaning to any one.

Very early in the days of alchemy the commoner substances used by them were represented in their writings by symbols, and the same is true regarding many operations of their art. The origin of these symbols is sometimes easily recognized; in other cases they seem to have been products of the fancy. Among the earliest of these symbols are those used for the metals, and their germ is to be found in the earliest days of history.

In the misty times of the past there lived in the great plain at the head of the Persian Gulf a race whose wisdom was famed to surpass that of all surrounding peoples. In the clear atmosphere of that region they watched from the summit of high mounds the stars and movements of the planets in their courses, seeking to trace a connection between the heavenly bodies and the affairs of earth. Here, among the Chaldeans, was born astrology, the mother of astronomy. Here, too, are found the beginnings of alchemy, which three thousand or more years later was to develop into the science of chemistry.

The Chaldeans associated the metals known to them with the planets, and believed that through their influence the metals grew in the earth. The planets in turn were closely connected with the gods and goddesses of the pantheon of mythology. This three-fold association of metals, planets and divinities seems for many centuries to have been dormant, but was revived by the alchemist, and by them the metals were always called by the name of the planet. In gold was typified the bright yellow glow of the sun; in silver, the soft white light of the moon; in iron, the weapons of steel of Mars, the war-god; in copper, Venus Anadyomene, rising, full-formed, in all her beauty from the ocean's foam on the shore of the island of Cyprus, from which comes the name of copper. Lead, which however we may polish it soon loses its brightness, was the metal of Saturn, dullest of all the gods; tin, known in early times only in bronze, its alloy with copper, was the metal of Jupiter, who, under the name *Bel*, was always associated by the Chaldeans with Venus, called by them *Beltis*. Finally in quicksilver was found the fitting type of Mercury, fleet-footed messenger of the gods. Some of these designations have been retained even to the present: quicksilver is commonly known as *mercury*, silver nitrate is called *lunar caustic*, and *saturnine* poisoning prevails among lead-workers.

In the old alchemistic writings we find the names of the metals very generally written with the astronomical symbols of the planets, and from these symbols has been developed, through many changes, the present simple system of one-letter and two-letter abbreviations used in modern chemistry.

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†Washington and Lee University.

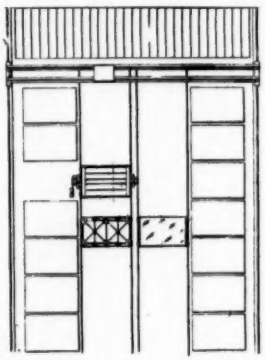
Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of United States Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

Apparatus for Handling Plates of Glass or the Like. U. S. 1,446,003. Feb. 20, 1923. William Duster, Butler, Pa.

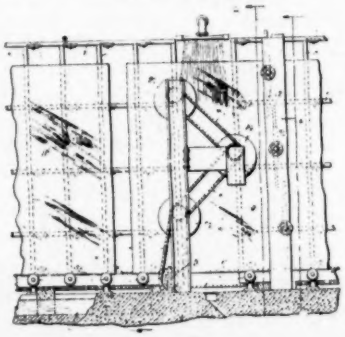
This invention relates to apparatus for turning plates of glass in the process of grinding and polishing such plates on both sides. By the use of his invention, the inventor claims, breakage is avoided because the plates are supported throughout the major portion of their area on both sides, during the turning operation, as a result of which the plates are not subjected to any transverse strains and therefore never broken. Furthermore, the plate may be handled with less care, and therefore more rapidly.



In operation a plate of glass is taken from the rack by the crane and deposited at the desired point. A table is then brought into position and covered over with plaster. The plate of glass is then placed upon the plaster in the ordinary way and the table with the glass thereon is placed on a truck, which is usually on the tracks shown in the illustration. The truck is provided with antifriction rollers and when the same has been run along the tracks to the proper position, the table with the plate of glass thereon is moved into one of the grinding machines. The plate is then ground, and after it has been ground it is again run onto a truck. A truck on the adjoining tracks is then run into line with the first mentioned truck and the table is moved across onto the truck and from there it is carried into any one of the polishing tables whereupon the glass is polished. After the polishing operation, the table with the glass thereon is run onto a truck and carried to a device for turning the plate so that it may be ground and polished on the other side.

Plate-Glass. Washing and Cleaning Apparatus. U. S. 1,448,062. March 13, 1923. John Krupeany, Rossford, Ohio.

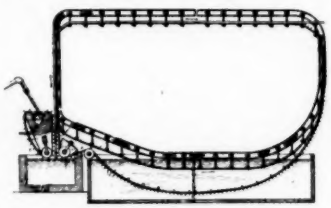
This invention relates to the manufacture of plate glass and particularly to an apparatus for cleaning the glass after a polishing or grinding operation.



In the use of this apparatus, glass sheets to be cleaned are successively placed on the rolls at the left end of the apparatus and fed slowly forward to the right end of the apparatus by the rotation of the rolls. When a sheet is over the acid bath the acid is applied to the front surface thereof to soften the cement adhering thereto, and a considerable portion of the cement will fall from the sheet by reason of the acid action. The remaining portion of the cement is brushed from the sheets by the scrubbing action of the brushes and the flowing of the water or other cleaning liquid thereon, after which the sheets pass between the wiping strips which remove any water, cement or other matter remaining thereon. The rear set of wipers is intended merely to wipe the rear sides of the sheets of water or other liquid which may have been accidentally applied thereto.

Glass-Drawing Apparatus. U. S. 1,449,038. March 20, 1923. William Gray, of Lancaster, O.

The present invention relates to apparatus for drawing glass sheets, and the object in view is the provision of novel and effective means for preventing the contraction of the sheet adjacent to its juncture with the body of glass from which it is formed.

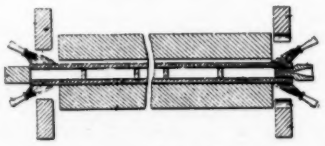


In the embodiment disclosed, a portion of a reservoir or tank for molten glass, is indicated and may be of any desired or well-known construction. Located adjacent thereto is drawing means, comprising an endless carrier member. The same includes hangers supporting an endless series of hingedly connected plates, and provided with rollers that operate in a guideway. This carrier has a vertical stretch located above the reservoir, and its lower portion which moves toward said vertical stretch, passes through a cooling bath. The sheet glass is drawn from the reservoir, and is carried upwardly against the face of the plates on the vertical stretch. It then passes horizontally rearwardly.

As the sheet is continuously drawn upwardly from the batch of metal, vertical stretches of the chains move upwardly therewith and teeth clamp both margins of the glass, thus preventing its tapering off under the strain of the drawing operation.

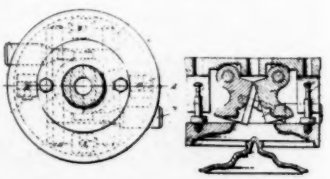
Process of Making Hollow Panes of Glass. U. S. 1,448,351. March 13, 1923. Ivan M. Kirlin, of Detroit, Mich.

The invention relates to a process of forming hollow panes of glass which consists in heating two similar sheets of glass between flat retaining plates, introducing a tube between the edges of the sheets at one point, heating the edges to fusing point and forcing them together and around the tube to hermetically seal the edges together and the tube in position and at the same time forcing air through the tube into the space between the sheets to hold them against the retaining plates, cooling the pane until no longer malleable, and then exhausting the air from its interior.



Mold. U. S. 1,449,808. March 27, 1923. Harry R. Boals, of Corning, New York, assignor to Corning Glass Works, of Corning, N. Y.

The invention relates to molds for pressing glass or other articles and particularly articles having an integral knob or projection connected therewith by a restricted neck. It is especially useful in making pressed glass covers for dishes having a knob or projecting handle.



The invention comprises a base having a pair of integrally formed ears to each of which is pivoted one of a pair of sectional auxiliary mold members similar in form which, when closed, provide a cavity for forming the knob or projection and the restricted neck. Each of these sections is provided with a weight so positioned as to assist the parts in opening

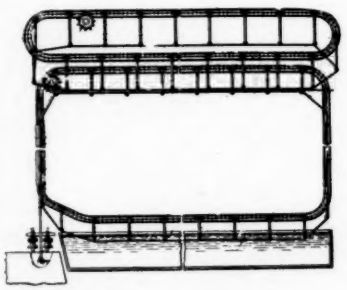
and closing upon inversion and return of the mold as hereinafter described.

The weights are so constructed that upon inversion of the mold, they strike the main mold, arresting the opening motion of the auxiliary mold parts, and thus prevent the center of gravity of the auxiliary mold to which it is attached, from reaching the vertical line passing through its pivot, and preventing injury to the main and auxiliary molds.

Among the other claims the inventor includes a mold having a base, a plurality of auxiliary mold members pivoted thereon, and a main mold slidably mounted upon such base to and from the auxiliary mold members, the pivots of the auxiliary mold members being outside of the joint between the auxiliary mold members and when the mold is in pressing position being below the joint between the main mold and the auxiliary mold members, the centers of gravity of each of said auxiliary mold members being off-set with respect to its pivot in the direction of the other auxiliary mold member.

Glass—Drawing Apparatus. U. S. 1,450,590. April 3, 1920. William Gray, of Lancaster, O., assignor to the Libbey-Owens Sheet Glass Company, of Toledo, O.

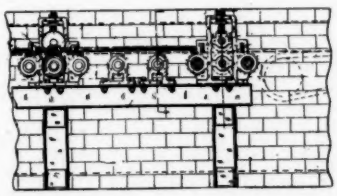
This invention relates to apparatus for producing glass sheets and provides for a reservoir or tank for molten glass which may be of any desired or well-known construction. Located adjacent thereto is drawing means comprising an endless carrier member. The same consists of spaced endless cable members which may be sprocket chains operating in suitable guideways and carrying hangers, the hangers having offset pintles on which are journaled rollers operating in said guideways. The free ends of the hangers are provided with eyes in which are mounted transverse pivot rods that connect corresponding hangers of the sprocket chains. The pivot rods constitute connections for an endless series of plates that are thus supported by the hangers as shown.



The endless carrier, as thus constructed, has a vertical stretch located above the reservoir or tank, an upper substantially horizontal offtake stretch, a rear downwardly moving stretch, and a return stretch. Located below the stretch is a tank for a cooling medium, through which the plates pass.

Lehr Conveyor for Sheet Glass. U. S. 1,450,571. April 3, 1923. Horace E. Allen, of Toledo, O., assignor to the Libbey-Owens Sheet Glass Company, of Toledo, O.

In certain systems of drawing sheet glass, for example, the Colburn process, a continuous sheet of glass is drawn from a molten source, and, after being flattened, is passed horizontally through a rather long lehr, or annealing chamber, in which the temperature gradually decreases from the end where the sheet enters to the end where the sheet passes out to the cutting tables. Different forms of conveyors may be used to advance this continuous sheet through the lehr, the usual type comprising a series of spaced driven rollers which carry the sheet. The fine fire-polished surface of the sheet is easily scratched and any sliding movement against foreign surfaces, such as that of the rollers, is to be avoided if possible. These rollers are all driven at the same speed from a common source. Now, unless the peripheral speed of these rollers is exactly equal to the speed at which the sheet is fed to the lehr by the sheet-drawing mechanism, there will be some relative movement between the sheet and the contacting surfaces of the rollers. Also, due to the contraction of the sheet as it cools, the speed of travel of the sheet is not constant throughout the length of the lehr, and if the rollers are all driven at the same speed, some of them must have more or less sliding contact with the sheet.



The object of the present invention is to avoid as far as possible this relative movement between the surfaces of the sheet and the supporting rollers, and hence avoid the scratching of the sheet surface due to this sliding contact. In this improved conveyor, the series of spaced supporting rollers are all idlers, and are mounted on anti-friction bearings, so that they roll freely and their peripheral speed will conform to the speed of the sheet supported thereon. The various speeds of the rollers throughout the lehr may vary in accordance with the speed of the sheet at the different points. The sheet is advanced through the lehr by a second series of driven rolls, arranged at intervals throughout the lehr, which engage only a narrow edge portion of the sheet at each side thereof. Since this edge portion has already been marred by the sheet-drawing process, and must eventually be discarded, any slipping or scratching between these edge driving rolls and the sheet is immaterial, and it is not essential that the speed of the rolls be adjusted with the nicety necessary with conveyors now in use.

Ovenware and Holder Therefor. U. S. 1,450,330. April 3, 1923. Harry Negbaur, of New York, N. Y., assignor to E. & J. Bass, Incorporated, New York, N. Y.

This invention relates to improvements in oven baking ware made of glass of low expansion. Certain baking ware now in very common use is understood to be made of a boro-silicate glass such as that described in Sullivan and Taylor Patents Nos. 1,304,622 and 1,304,623 of May 27, 1919. All such ware, while most satisfactory as a baking dish, is not pleasing in appearance on account of a pale yellowish tinge in the glass. This marring of the beauty of these dishes is especially noticeable when they are used in silver or nickel frames. The yellowish tinge and silver do not harmonize.

An object of this invention is to improve these baking dishes without sacrificing any of their valuable properties by applying to them, preferably on the outer surface, a coloring material whereby the dish and holder may harmonize, the material to be such that it will permanently retain its color, will not wash off, or contaminate the food.

A composition containing a mineral pigment of desired coloring and a suitable vehicle is applied to the outer surface and the inventor claims that he has found that vitreous compositions containing suitable metallic oxides in borosilicate of lead as a vehicle and fluxing agent are most suitable. This may be done with an air brush or by hand with an ordinary brush, or by dipping. The color may be uniform as to color and density all over the surface of the dish, or it may be varied in any desired way as to color and density to produce artistic designs. Among the colors which harmonize well with silver are green, blue, pink and canary, the corresponding pigments being chrome green oxide, cobalt oxide, purple cassius and antimoniate of lead.

After the coloring material has been applied, the dishes are placed in a kiln, fired at a temperature of about 800 degrees Fahrenheit for about three hours, in order to drive off the organic vehicle and fix the metallic pigment in the glass. The pigment enters into the glass and gives it a permanent color, hiding the original yellow tinge. It also renders the dish somewhat translucent.

This finishes the process.

The Glass World and What It Is Doing

News of the Industry

The Glass Industry in Mexico*

By Burt C. Blanton†

Within a territory of 767,000 square miles, with a population of approximately 16,000,000 people, we find one of the oldest, yet one of the youngest, from the standpoint of development and natural resources, nations in the western hemisphere.

Industrially, great progress has been made within the last few years in Mexico, the results of which, in part, follow: 3,805 industries, divided as follows: Food industry 693, metals 614, textiles 213, electric 40, and miscellaneous 2,245, representing a capital investment of approximately $120,000,000. Due to a marked industrial growth since the census, no doubt today the figures would be much greater.

However, among this diversified field of industry we find today only one modern glass manufacturing works in the republic, the same being situated in the city of Monterey, capital of the state of Nuevo Leon.

In the year 1909 the Vidriera Monterey, S. A. (Monterey Glass Works) was constructed, and represents a capital or initial investment of $1,500,000, employing over 600 persons at maximum capacity.

It is a Mexican corporation, holding the patent rights of the Owens and Graham machines in the republic of Mexico, with the exclusive right to manufacture under said processes.

The plant site comprises approximately fifty acres of land adjacent to the city, upon which have been erected modern brick and stone buildings as enumerated: Two-story general office building; three main plant buildings, 108 feet wide by 350 feet in length; stock building, 25x300; storage building, 30x400; general floor machines building, 20x50; silica building, 40x275, and boiler house.

Crude oil from the Tampico fields is utilized as fuel, with a storage capacity at the plant of 1,500,000 barrels. The corporation owns considerable rolling stock, including fourteen standard oil tank cars and one locomotive.

All machines have individual electric drive. The departments comprising the complete industry include machine shop, tool, mold, pipe fitting, blacksmith, bottle machine, furnace, annealing, etc.

The equipment consists of three Graham and four Owens machines for the manufacture of bottles, the total production of the seven machines being 4,000,000 bottles monthly. The capacity of the machines on an eight-hour basis is 10,000 minimum, with 20,000 maximum.

Beginning with the process of manufacture, the components of glass are sand, soda ash, lime and cullet. These raw materials are mixed in the proper proportion as required, weighed and placed in a batch mixer and revolved at a speed of twenty revolutions per minute for fifteen minutes.

The average batch consists of 5,460 pounds of ingredients, and after a thorough mixture it is automatically discharged into elevating conveyors; the elevating conveyors in turn deliver the batch into a distributing conveyor, whence it is distributed to the furnace hoppers.

The equipment used for melting the batch consists of five furnaces constructed of fire clay materials (flux, refractory and silica); two 29-ton and three 39-ton units, stated capacities being molten glass, based on 17 square feet per melting area. The furnaces are divided into two sections, known as a melting tank and a refining tank, the two being connected by a throat 18x24 inches.

The raw batch in the furnace hoppers passes through automatically controlled gates and flows into the mouth of the furnace, which is known as the "dog house." This automatic feeding process takes place every thirty minutes.

The batch having been delivered to the melting tank, which is held at a constant temperature of 2,450° Fahrenheit; then travels thirty feet to the throat of the furnace; during this interval of time the batch reaches a molten state and flows through the furnace throat into the refining tank, the refuse and impurities remaining in the melting tank.

The refining tank is connected with a revolving pot, the molten glass flowing into the same by means of a maximum glass line, the drawing of the glass being accomplished by the rotation of the pot. The glass is then ready to be transferred from the revolving pot to the machines.

The Owens and Graham type machine rotates over the revolving pot; each section, containing a blank mold, dips into the pot of molten glass, and by the maintenance of a 28-inch vacuum a sufficient quantity of the glass is drawn into the mold of the machine to form a bottle, the temperature of the molten glass being 2,200° Fahrenheit at this stage.

Following the cycle of rotation, the mold now containing the glass passes beyond the revolving pot, thereby causing a repetition of the operation by the second blank mold. The filled mold, moving forward in the revolving process, passes a cutter, which shears the tail end of the protruding glass from the under side of the mold, the same having remained after the dipping and vacuum action.

The glass within the mold forms the body of the bottle, due to an emission of compressed air under a pressure of twenty pounds per square inch. The same is then ready to be blown, and the blank mold in the process of rotation transfers the body of the bottle into the finishing mold. The finishing mold immediately closes and the bottle is blown by compressed air under a pressure of fifteen to thirty pounds per square inch, contingent upon the size of the bottles, ranging from one-half ounce to a one-gallon packer.

As the machine nears the completion of its cycle the finishing mold opens, discharging the finished product into a wooden canal, through which it travels by gravity to table where a setting-up process takes place and the bottle is transferred to a belt conveyor, which in turn delivers the product to the annealing ovens, where the bottle enters at a temperature of 1,100° Fahrenheit.

The annealing ovens, comprising six in all, are constructed of refractory brick and are 12 feet wide by 125 feet in length. The bottles entering the annealing oven travel upon a cast iron endless belt which is 6 feet 6 inches in width. The capacity of each annealing oven is approximately 20,000 bottles, depending, of course, upon the diameter of the bottle.

To reiterate, the bottle enters the annealing oven at a temperature of 1,100° Fahrenheit, and through automatic damper regulation the same is gradually cooled to atmospheric temperature in the process of traveling the 125-foot length of the oven, which requires a time interval of nine hours.

Upon the discharge of the bottles from the annealing ovens, the same are carefully examined by competent men and assorted according to the grade and quality. Any of the finished product containing defects is transferred to box hoppers and later returned to the furnace hoppers in the form of cullet.

The perfect bottles, after being placed in crates, are transferred to the packing room by automatic conveyors, where they receive a second inspection. The bottles are then placed in shipping crates and are then ready for the consumer.

All classes of bottles, ranging from one-half ounce to one-gallon capacity, are manufactured by the Vidriera Monterey, S. A., together with fruit jars and containers of every description.

These products are distributed and sold throughout the republic of Mexico and the Central American countries.

*Times-Herald, Dallas, Texas.
†Mechanical Engineer, Dallas, Texas.

Society of Glass Technology

The annual election of officers for the Society of Glass Technology was scheduled to take place at the annual meeting, April 18, 1923. The following nominations were made:

President: Prof. W. E. S. Turner, O. B. E., D. Sc., M. Sc., F. Inst. P.

Vice-presidents: E. A. Coad-Pryor, B. A., and W. J. Gardner.

Ordinary members of Council: F. F. S. Bryson, M. B. E., M. A., B. Sc., F. Inst. P.; C. S. Davey, Violet Dimbleby, B. Sc., Major G. V. Evers, Col. S. C. Halse, C. M. G.; Th. Teisen, B. Sc., C. E.

Treasurers: Joseph Connolly (General), Wm. M. Clark, Ph. D. (American).

Secretary: F. Graves Clark.

Assistant Secretary: S. English, M. Sc., A. I. C.

Two vice-presidents and five members of the Council are elected each year. The results of the election had not been learned up to the time of going to press.

The Society at the beginning of 1923 had 649 members, comprising 1 honorary, 133 collective, 513 ordinary, and 2 student members. The number of foreign members was 177, of which 104 are residents of the United States.

The condition of the Society, financially, is excellent.

Provisional arrangements have been made for members of the Society to visit Paris and for the holding of a Society meeting there during the week of June 2nd to 9th. M. Delloye of Glaceries de St. Gobain, Chauny and Cirey, has kindly offered to arrange a program including visits to various glass works, sand quarries and other places of interest in the neighborhood of Paris.

Second National Merchandise Fair

Plans for the second National Merchandise Fair which covers glassware, lamps, etc., as well as many other lines are well advanced and the occasion promises to eclipse the successful initial exhibition held last year in New York. The increasing importance of the Fair is emphasized by the announcement that this year an additional building has been provided to meet the requirements of the huge industrial display. In addition to Grand Central Palace and the 165th Regiment Armory, the Lexington Theatre has been obtained and will be devoted to the Fashion Show, which proved such a popular feature last year.

Another factor of significance in connection with the Fair is the decision of the Federal Government to co-operate, through the Bureau of Foreign and Domestic Commerce of the Department of Commerce at Washington. This year the Bureau will maintain a booth in Grand Central Palace for the purpose of furnishing information and data to foreign visitors. The inaugural Fair attracted merchants and buyers from many distant countries, despite a lack of such facilities.

Among the lines that will be displayed in Grand Central Palace are the following: Silks, cottons, woolens, linens, draperies, curtains and upholsteries; art needlework, jewelry, silverware, neckwear, veilings, perfumes, embroidery, handkerchiefs and trimmings; house-wearing apparel, sports wear, hosiery, gloves, infants' wear, tot wear, and negligees; house furnishings, leather goods, toys, dolls, pictures, lamps, glassware, books, stationery and gift merchandise.

In the United States a country of 110,000,000 people scattered over an enormous area, without customs divisions between the states, without people speaking the same language and having largely the same merchandise requirements, there is an opportunity to build a merchandise fair on a scale so immense as to dwarf even the greatest achievements of the largest and oldest fair in the old world. The great growth of markets in the United States makes it practically impossible for retail buyers to keep in touch with all the great markets of the country. Thoughtful buyers, therefore, will welcome the development of a great central market event such as the National Merchandise Fair.

Admission to the fair will be limited to merchants and buyers who will register upon their first appearance at the Fair and receive special season passes. An attendance of 50,000 is expected.

Bureau of Mines Investigating Refractories

The itinerary of the Bureau of Mines laboratory car "Holmes" which recently began research work in refractories at the plant of the American Refractories Company in Baltimore, Md., includes after a month's stay there, visits to six other plants, situated at Brooklyn, N. Y.; Womelsdorf and Salina, Pa.; Hayward Station and Taylor, Ky.; and Ottawa, Ill. This work is under the immediate supervision of G. A. Bole, superintendent of the Bureau of Mines Ceramic Station, Columbus, O., and under the general supervision of the Division of Mineral Technology of the Bureau, of which Dr. R. B. Moore is chief and Dr. L. I. Shaw, assistant chief, collaborating with the Fuel Division, of which O. P. Hood is chief.

The work is being done by the Bureau in co-operation with a committee of the Refractories Manufacturers Association, of which S. M. Kier, of the Kier Fire Brick Company, Pittsburgh, Pa., is chairman. The objects of the investigation are to decrease fuel consumption in burning refractories, to shorten the time of burning, and to improve the quality of the product.. The car serves as laboratory and living quarters for the crew conducting the investigation, which consists of seven technical men, a cook and mechanic's helper. The technical force consists of four ceramic engineers and three fuel engineers, all of whom have had experience on problems of this type. The ceramic men are E. P. Ogden, foreman in immediate charge of the work, Alfred Whitford, A. E. Rupp and A. H. Fessler. The fuel engineers are W. E. Rice, car manager, R. F. Lunger and F. Wentzel.

Refuses to Consider Patent Case

Reports from Washington on April 9 stated that in the case of the Window Glass Machine Company and the American Window Glass Company, sought to bring up for review a case against the Pittsburgh Plate Glass Company in which the Federal District Court for western Pennsylvania held that the patents had not been infringed. The Supreme Court refused to consider the validity of the basic patents involved in the conversion of the glass industry from a hand-blowing to a machine-drawing art. It was contended by the companies interested in maintaining control under the patents that in a long list of adjudicated cases presenting similar controversies the federal courts had sustained the validity of the patents. The main patents at issue, it was asserted, had "revolutionized" the industry.

The Third Circuit Court of Appeals affirmed the decision of the District Court, which, it was declared, had reversed a long line of decisions.

The bill now before the Pennsylvania state legislature, which provides for the abolition of glass drinking cups from all public eating and drinking places, such as soda fountains, hotels and similar places, is strongly opposed by the American Association of Flint and Lime Glass Manufacturers. The matter was discussed at the Association's quarterly meeting at Wheeling, W. Va., early in April under the chairmanship of M. W. Gleason, of Gleason-Tiebout Company, Brooklyn, N. Y., the president of the organization. The contention made by the proponents of the measure is that individual paper drinking cups are more sanitary than glass, and hence will contribute to the general good of the public health. The glass men take issue on this point and state that paper used in the manufacture of such products is refuse and waste paper that has been used for other purposes. They claim that the paper manufacturers are sponsoring the bill and that their only interest therein is their profits from the sale of the product and not the public health. A similar bill met defeat in the Pennsylvania legislature several years ago.

A new gymnasium, said to be one of the largest and best in the city of Grafton, W. Va., has been equipped for the use of the employees of the **Hazel-Atlas Glass Company** in that city. It is approximately 35 by 70 ft. in size, has a good hard wood floor and is well lighted. Bleachers run along one side of the building and will accommodate 300 persons. At one end are locker rooms and shower baths. The gymnasium will be used during the coming summer as a dressing room for a baseball team and for boxing, wrestling and basketball. Next fall the plant will

have departmental basketball teams competing in a regular arranged schedule and will have a representative team to compete with teams from surrounding towns. In connection with this gymnasium a restaurant, primarily for the use of employees, has been installed.

National Safety Code for the Protection of the Heads and Eyes of Industrial Workers. Second edition. United States Bureau of Standards. For sale by the Superintendent of Documents, Washington, D. C. Price 10 cents. The code first presents the general requirements, including a classification of the occupations which require eye protection. There then follows the detailed requirements for each group of occupations, operating rules, and finally the specifications for tests, including that of glass for lenses and windows of eye protectors, which must be met to insure that protectors will adequately fulfill their purpose.

The procedure of the Consolidated Classification Committee, in handling classification matters is outlined in Bulletin No. 41 issued April 7 by J. T. Hendricks, director of traffic, Glass Container Association. The contents of the bulletin are of interest and value to shippers who may desire changes in existing provisions, or to add new items or present statements or petitions.

A shortage of domestic fluorspar which, in the event of a war, would very seriously affect the manufacture of basic open-hearth steel as well as the pottery and glass industries and the manufacture of hydrofluoric acid is feared by mineral experts at Washington, who state that domestic resources have been seriously depleted and, with one exception, no new deposits located. There is no satisfactory substitute for fluorspar in the making of steel. Cryolite is used, though infrequently, in place of fluorspar but as the only commercial deposit is in Greenland this might become an uncertain substitute.

Important ruling in patent case.—In the interference pending between Steimer, assignor to Hartford-Fairmont Co., Howard, and William J. Miller, the Commissioner of Patents, upon motion of Miller, has decided that no broad apparatus claims covering the suspended gob plunger feeder will be issued to Steimer.

The eleventh annual meeting of the **Chamber of Commerce of the United States of America** will be held in New York City, May 7 to 10, 1923. The program will center around the subjects, "Transportation in All Its Phases in the United States" and "European Conditions from the American View Point."

The spring meeting of the American Society of Mechanical Engineers will be held at Montreal, Canada, May 28 to 31.

The American Flint Glass Workers' Union will hold its annual convention at Baltimore, Md., beginning July 2, 1923.

D. C. Jenkins Very Much Alive

A false report of the death of D. C. Jenkins, president of D. C. Jenkins Glass Company, Kokomo, Ind., gained considerable circulation throughout the trade early in April and has kept Mr. Jenkins busy denying the report and receiving the congratulations of his many friends who were overjoyed to learn that the report was untrue and that he is very much alive and enjoying the best of health at the present time. The unfortunate error was an instance of mistaken identity, Mr. D. C. Jenkins' cousin, John W. Jenkins, of Kokomo, having died early in the month.

Verified News of Trade Activities

The Lima Plate and Window Glass Company, Lima, O., has increased its capital from $20,000 to $50,000.

The United States Glass Company, Pittsburgh, Pa., reports its earnings for the March quarter as $1,352,111, against $970,647 for the same period of 1922.

A new machine shop for the **Hazel-Atlas Glass Company** will be added to their Wheeling, W. Va., plant. A one-story building 60 feet by 180 feet and 25 feet high is planned.

The Century Glass and Paint Company, Cleveland, O., has been incorporated with a capital of $100,000 by Charles E. Keske, Theodore A. Nolte, Eugene G. Keske, Minor G. Norton and William H. Evers.

Henry Lange, Inc., Kearny, N. J., has been incorporated with a capital of $25,000 to manufacture glass products. The incorporators are: C. Martens and Henry Lange, 177 Windsor street, Kearny.

Diederich & Paquet, 4 Passage des Postes, Brussels, Belgium, have announced that they are prepared to furnish all grades of raw or ground fluorspar suitable for the manufacture of glass.

The Kearney-Dailey Glass Company, 407 North Elizabeth street, Chicago, Ill., has been incorporated with a capital of $100,000 to manufacture glass products. The incorporators are: James M. Dailey, Thomas S. Kearney and James J. McMahon.

The Sipes Cut Glass Company, Inc., manufacturers of cut glas, have moved their factory from Harrisburg, Ark., to Jonesboro, Ark., where they will have better railroad facilities for shipping their product. According to A. W. Hailey the company is in the market for new items in glass.

Heavy damage was caused April 7 by a fire which destroyed a large part of the cutting rooms at the Arnold, Pa., plant of the **American Window Glass Company.** Reconstruction was begun at once and it is expected that operations will be resumed before the end of May.

The Rockford Plate & Window Glass Company, Rockford, Ill., plans the erection of a new factory building of fireproof construction to take the place of the building which was recently destroyed by fire, as soon as insurance claims are adjusted.

The Royal Window Glass Company's plant at East Grafton, W. Va., has been rebuilt and machinery is being installed which will eliminate hand blowing and greatly increase the output. According to W. J. Hammond, treasurer of the company, the plant will be in operation about June 1.

Fire, which was started by a bursting tank, did about $60,000 damage at the plant of the **Upland Flint Glass Company,** Upland, Ind., on April 2. The building which was destroyed is being replaced with a fire proof structure and it is expected that the factory will be in operation again by May 10.

The Roulette Glass Company, according to press reports, has been organized at Roulette, Pa., to take over the V. & S. Bottle Company of that place. The officers of the new company include: G. S. Goff, Corning, N. Y., president; C. A. Rohland, Buffalo, N. Y., vice-president; W. G. Van Kuren, Roulette, treasurer, and Thomas F. Rogers, secretary.

The Ouachita Glass Company's factory at Bastrop, La., was recently sold under foreclosure proceedings to representatives of the Frost-Johnson Lumber Company of Shreveport, La. The purchase price was $12,500, which will cover fees for the administration of the receivership, taxes and a few other preferred claims. It is reported that the purchasers of the plant will organize a new company to be known as the Bastrop Glass Company and it is expected that operations will be resumed early in the summer.

The Combustion Engineering Corporation, Ltd., and the **Uehling Instrument Company** have recently entered into an agreement whereby Uehling interests in the Dominion of Canada and Newfoundland will be handled exclusively by the Combustion Engineering Corporation, Ltd., with principal offices located in Toronto, Montreal, Winnipeg and Vancouver. The Uehling line includes fuel economy equipment such as CO_2 recorders, SO_2 recorders, draft recorders, combined barometer and vacuum recorders, absolute pressure indicators, etc.

Correcting inaccurate statements which recently appeared in the daily press regarding the progress of the Libbey-Owens sheet glass manufacturing process, the **Libbey-Owens Sheet Glass Company,** Toledo, O., state that in addition to the American plants they have had plants running in Japan for three years and in Canada for one year. A six-machine plant, located at Moll, near Antwerp, Belgium, will be in operation by May 1. Another one-machine plant, located at Moutier, Switzerland, will be in operation during the month of May. Work has begun on factories in Spain and France.

The Tampa Glass & Bottle Manufacturing Company, Tampa, Fla., is remodeling its plant and expects to start operating in June. A new furnace is being installed by the Ohio Valley Clay Company of Steubenville, O., and lehrs by the Amsler-Morton Company of Pittsburgh, Pa., under the supervision of The Cox & Sons Company, of Philadelphia, Pa. When operations were first begun at the plant last year it was found that due to faulty construction it was impossible to produce containers on a profitable scale and the plant has not been working for some months. It is believed that as soon as alterations have been completed it will be possible to compete very favorably for the local trade with other container factories.

Expansion in the blown and pressed ware field is indicated by the large number of orders for glass-making equipment placed with machinery manufacturers recently. The Miller Glass Engineering Company recently shipped two of their latest improved automatic glass feeders to the Lamb Glass Company, Mt. Vernon, O. One of these feeders was shipped four days after receipt of order making a total of five furnished, four of which are operating on milks in conjunction with the William J. Miller eight-mold type PC machine. The average production of these machines on quarts is reported to be 525 dozen per shift. The company also reports orders received recently from Belgium for a standard KFO feeder, from Atlantic Bottle Company for four eight-mold model P. machines for milk bottles and from the Consumers' Glass Company, Montreal, for a similar machine for use on a general line of wide mouth packers' ware.

Announcement was made recently of the purchase by Pittsburgh, Chicago and Philadelphia capitalists of the Heidenkamp plate glass factory at Springdale, Pa., and the reorganization of the company as the **Heidenkamp Plate Glass Corporation** with a capital of $3,000,000. The factory, which has a capacity of 2,500,000 square feet, is to be enlarged and the product sold direct to jobbers, many of whom are interested as stockholders. The officers are: Warren Hires Turner, president; Frank E. Troutman, vice-pesident, and general manager; Joseph Heidenkamp, Jr., secretary, and John E. Allen, treasurer. The board of directors include: Joseph Heidenkamp, Pittsburgh; chairman, W. H. Turner, Philadelphia; Louis A. Hippach, Chicago; Frank R. Frost, Pittsburgh; Neilson Edwards, New York; James R. Miller, Pittsburgh, and Stanhope S. Goddard, Pittsburgh. Joseph Heidenkamp Jr., is plant superintendent. The Company, through Redmond & Company, New York, are offering a new issue of $1,000,000 first (closed) mortgage 6½ per cent twenty-year bonds.

Business Publications

Amco Type Continuous Muffle Lehr. An 8-page pamphlet just issued by the Amsler-Morton Company, Pittsburgh, Pa. Describes the development of the Amco continuous lehr of the long muffle type, explains its salient features and illustrates the details of construction. A table of annealing schedules for different kinds and thicknesses of glass is given, also a graphical annealing schedule for commercial ware.

Personals

C. M. Stein of France, inventor of the Stein recuperative furnace built by the Chapman-Stein Furnace Company, Mt. Vernon, O., arrived recently in this country on a business trip. Mr. Stein, who is president of the Ste. Anme Des Appareils de Manutention & Fours Stein, Paris, France, while here is making his headquarters at the New York office of the Chapman-Stein Furnace Company, 50 Church street.

Charles W. Brown, president of the Pittsburgh Plate Glass Company, and Mrs. Brown and their two daughters, recently arrived home after a four months' trip around the world. They were accompanied on the trip by H. K. Hitchcock, consulting engineer of the Pittsburgh company, and Mrs. Hitchcock.

Deaths

Thomas F. Stevenson, former official of the United States Glass Company and director of the Manufacturers' Bank, both of Pittsburgh, Pa., died at his home in that city on April 12. Mr. Stevenson, who was 64 years of age, was connected with the United States Glass Company for a period of 34 years. He is survived by two sisters.

Sir James Dewar, the noted British scientist, died on March 27 in his eighty-first year. He was the inventor of the Dewar flask, popularly known as the thermos bottle. The deceased was a graduate of Edinburgh University where he specialized in chemistry. The greater part of his life was devoted to research, mainly in the field of chemistry. For a time he was director of the Davy-Faraday Research Laboratory and held professorships at St. Peters College, Cambridge. He was knighted in 1904.

Inquiries Received

For further information address THE GLASS INDUSTRY

126. Please send names of cullet dealers in New York. I want a quotation on 60 tons of clean milk bottle cullet free from colored glass, wires, corks, etc.

127. Would you have the kindness to give me some information as to non-cracking glass? I wish to fuse a coating of a glass-like substance on metal which has some flexibility. The difficulty is naturally that ordinary glass is not sufficiently flexible and will chip off.

128. Kindly give us the names of concerns making magnifying mirrors for vanity cases.

129. Where can we obtain an electrically operated bead-making machine?

130. Where can we obtain a press for putting designs on illuminating glassware?

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

PITTSBURGH STOCK EXCHANGE APRIL 21, 1923.

	Bid	Asked	Last
American Window Glass Machine, com..	85	86	85
American Window Glass Machine, pfd...	94	94½	94½
American Window Glass Preferred.....	107½	110	107½
Pittsburgh Plate Glass.....	170	171	170
U. S. Glass (new stock).....	27¼	27½	27½

A quiet market has prevailed for the glass issues during the month. Quite recently some activity has been noticed in United States Glass and it is reported that the earnings of this company are running at a very satisfactory rate.

Pittsburgh Plate Glass was strong, but American Window Glass Machine common maintained about the same level during the month.

WHEELING STOCK EXCHANGE APRIL 21, 1923.

	Bid	Asked	Last
Hazel-Atlas	43	43½	43
Imperial Glass	99½	100½	99½
Fostoria Glass	140	142	140
Central Glass	90	100	90

During the month Hazel-Atlas has been quite active. Quite recently the par value of the stock was changed to $25 and four shares of new issued for each share of old. Rights were offered to stockholders entitling them to subscribe for one new share at par for each six shares held. Before the exchange the stock sold as high at 171¼ and reacted down to 158. The new stock was active when it came on the market, selling down to 38 and then advancing to its price level of around 43½. The other issues maintained an even tone with the exception of Fostoria, which was active on the upward price trend.

TOLEDO STOCK EXCHANGE APRIL 20, 1923.

	Bid	Asked	Last
Owens Bottle, common.....	47	48	47½
Libbey-Owens Sheet Glass, common....	132	137	134
Libbey-Owens Sheet Glass, preferred...	104	107	105

Current Prices of Glass-Making Materials

From quotations furnished by various manufacturers and dealers

April 21, 1923	Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)..lb.	.05	.05½
Aluminum oxide (Al_2O_3).....lb.	.05½	.06½-.07
Antimony oxide (Sb_2O_3).....lb.	.07	.07½
Arsenic trioxide (dense white), 99% (As_2O_3).....lb.	.15	.15½
Barium carbonate ($BaCO_3$)...ton	70.00	90.00
Barium hydrate ($Ba(OH)_2$)....lb.	.05½	.05¾
Bone ash .....lb.	.06	.06½
Borax ($Na_2B_4O_7.10H_2O$) .....lb.	.05½	.06
Borax, fused, any mesh ($Na_2B_4O_7$) .....lb.	.19	.20
Boric acid, fused (B_2O_3).....lb.	.35	.35
Cadmium Sulphide, red (CdS)..lb.	..	1.65
Cadmium Sulphide, orange.....lb.	..	1.65
Cadmium Sulphide, yellow (CdS) .....lb.	..	1.85
Chrome oxide .....lb.	.35	.36
Cobalt oxide, in bbls. (Co_3O_4)...lb.	..	2.10
Cobalt oxide, in 10 lb. tins (Co_3O_4) .....lb	..	2.20
Copper oxide, red .....lb.	..	.15-.16
Copper oxide, black (CuO).....lb.	..	.26
Copper oxide, black prep'd (CuO) .....lb.	..	.30
Cryolite (Na_3AlF_6) .....lb.	..	.09½
Feldspar, 100 mesh.....ton	14.00–16.00	20.00
Fluorspar, powdered white, 95% (CaF_2) .....ton	40.00	45.00
Fluorspar, powdered white, 90% (CaF_2) .....ton	33.00	38.00
Hydrofluoric acid (HF) 60%..lb.	.14	..
Kaolin .....ton	17.00	25.00
Lead oxide (red lead) (Pb_3O_4)..lb.	.11½	.11¾
Litharge (PbO) .....lb.	.11	.11¼

	Carlots	Less Carlots
Lime—		
Hydrated (in 50 lb. paper sacks) ($Ca(OH)_2$) .....ton	12.50	..
Burnt, ground, in bulk (CaO).ton	9.00	..
Burnt, ground, in paper sacks.ton	11.00	..
Burnt, ground in 280 lb. bbls. per bbl.	2.15	2.30
Manganese 85% (MnO_2).....lb.	.03½	.04–.05
Nickel oxide, black (Ni_2O_3) for nickel content .....lb.	.32	
Nickel monoxide, green (NiO) for nickel content.....lb.	.30	
Potassium carbonate—		
Calcined 90% (K_2CO_3).....lb.	.06¼	.06½
Hydrated 90% (KOH) .....lb.	.07	.07¾
Potassium nitrate (KNO_3) (gran.) .....lb.	.06½	.06¾
Potassium Permanganate ($KMnO_4$) .....lb.	..	.17
Powdered blue .....lb.	..	.24-.26
Powdered blue (std. formula)..lb.	..	.38
Salt cake, glassmakers, f. o. b. works (Na_2SO_4) .....ton	26.00	30.00
Selenium (Se) .....lb.	..	2.10–2.25
Soda ash, 58% dense, 48% basis Bulk (Na_2CO_3) .....100 lb.	1.22½	..
Bulk, on contract (Na_2CO_3) 100 lb.	1.17½	..
Sodium nitrate, refined ($NaNO_3$).lb.	..	.04¾–.06¼
Sodium selenite (Na_2SeO_3).....lb.	1.90	2.00–2.50
Sodium Fluosilicate (Na_2SiF_6)...lb.	.07¾	.08
Sulphur (S) (flowers)—in bbls. per 100 lb.	3.25	3.55–3.80
Sulphur (flowers) Bags per 100 lb.	3.00	3.30–3.55
Sulphur (S) (flour, heavy), in bbls. per 100 lb.	2.50	3.00
Uranium oxide—100 lb. lots (UO_3) .....lb.	..	2.25
Zinc oxide (ZnO) .....lb.	.07½–.08	.08–.08½

Monthly Summary of United States Foreign Commerce in Glass

[NOTE—Owing to continued delay in the import reports, only the December report is published at this time. Statements of imports for the months of 1923 will be published when received.]

Exports

Corrected to April 10, 1923	February 1922 Quantity	February 1922 Value	February 1923 Quantity	February 1923 Value	Eight Months Ending February 1922 Quantity	Eight Months Ending February 1922 Value	Eight Months Ending February 1923 Quantity	Eight Months Ending February 1923 Value
Glass and glass products (total).....	.....	$582,857	.....	$800,607	.....	$5,724,813	.....	$5,996,933
Plate and window glass—								
Window glass, common, box 50 sq. ft.....	2,437	$11,222	2,519	$13,220	12,718	$80,642	20,925	$119,457
Plate glass, unsilvered, sq. ft.....	342,453	140,160	214,464	88,071	1,479,723	673,428	1,441,974	559,394
Other window and plate glass, n. e. s.....lbs.	120,962	11,797	406,921	45,521	[2]248,346	[2]23,038	1,920,162	202,475
Glass containers (bottles, vials and jars).....lbs.	1,547,974	109,875	4,522,634	232,422	.....	1,595,270	35,235,409	1,804,031
Table glassware, plain.....lbs.	466,174	63,088	1,613,869	157,240	[2]787,198	[2]118,169	11,799,040	1,234,738
Table and other glassware, cut or engraved....lbs.	16,018	8,864	31,748	11,216	.....	75,358	374,164	145,378
Glassware for lighting—								
Lamp chimneys and lantern globes.....lbs.	98,088	20,203	161,687	33,547	[2]197,232	[2]41,414	967,315	187,320
Globes and shades for lighting fixtures.....lbs.	107,352	23,883	127,595	38,927	[2]203,247	[2]59,155	1,059,861	293,316
Lamps and other illuminating devices, chiefly of glass .....lbs.	65,531	26,374	100,714	32,563	[2]176,733	[2]79,620	708,126	225,145
Chemical glassware .....lbs.	50,808	15,153	23,803	10,582	.....	109,867	141,305	89,451
Electrical glassware, except for lighting.....lbs.	142,780	20,522	232,242	14,160	[2]223,808	[2]32,604	1,980,695	125,978
Other glassware, n. e. s.....lbs.	1,469,674	131,716	599,541	123,138	.....	2,836,248	5,576,201	1,010,250

[2]Jan. 1 to Feb. 28.

Imports

Corrected to April 3, 1923	December 1921 Quantity	December 1921 Value	December 1922 Quantity	December 1922 Value	Twelve Months Ending November 1921 Quantity	Twelve Months Ending November 1921 Value	Twelve Months Ending November 1922 Quantity	Twelve Months Ending November 1922 Value
Glass (total)	.....	$714,290	.....	$1,404,613	.....	$9,621,553	.....	$13,892,239
Cylinder, crown, and sheet, lbs.....dut.	3,639,338	$164,762	.....	.....	48,136,185	$2,638,834	[1]41,597,241	[1]$2,085,182
Unpolished, lbs.....dut.	.....	.....	3,350,243	$170,747	.....	.....	[2]11,254,210	[2]497,476
Bent, ground, beveled, colored, painted, etc., and polished .....dut.	.....	.....	.....	71,502	.....	.....	.....	[2]209,288
Plate glass—								
Unsilvered, sq. ft.....dut.	475,650	257,600	1,492,555	766,038	3,106,659	2,069,607	94,497,073	5,089,832
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft.....dut.	.....	.....	147,320	17,454	.....	.....	[2]523,589	[2]94,904
Containers—bottles, vials, etc.....dut.	.....	13,441	.....	22,077	.....	351,293	.....	299,645
Table and kitchen utensils, lbs.....dut.	.....	.....	99,023	34,608	.....	.....	[2]339,076	[2]130,084
Glassware, cut or decorated, lbs.....dut.	.....	115,361	186,777	89,464	.....	1,472,977	.....	2,033,135
Blown glassware, n. e. s., lbs.....dut.	.....	.....	422,095	94,768	.....	.....	1,483,247	370,141
Other glassware ..... free	.....	27,741	.....	.....	.....	627,702	.....	[1]106,800
Other glassware ..... dut.	.....	135,385	.....	137,955	.....	2,461,140	.....	2,975,752

[1]Jan. 1 to Sept. 21. [2]Beginning Sept. 22.